INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team Eiffel

Cognition and Cooperation in Design

Rocquencourt

THEME COG

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1. Team

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2. Overall Objectives

2.1. Overall objectives

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

The Eiffel team is a joint research group comprising members from 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 development 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 Open-Source Software (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; the role of local adaptations in the evolution of rules in cancerological therapeutic decision making; and mutual learning between users and designers.
- 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; developing methods for the design of new emerging technologies; and developping methos for the analysis of error production.

3. Scientific Foundations

3.1. Scientific foundations

Keywords: *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 [55].

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, primarity 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 to 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 also 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 [58], 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 with the other 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 [57].

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 [56].
- 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).

4. New Results

4.1. Introduction

EIFFEL’s research has been focusing on collective, rather than individual design, for several years now. 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 codesign, 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). Finally, the development of appropriate work environments, such as shared and private work spaces in computer-mediated design, requires analyzing the articulation between the different forms of reasoning implemented in both individually and collectively conducted activities.

4.2. Axis 1: 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 between people

at 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 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 people on 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 situations where 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. This concerns, for example, visibility of others, which may be a disruptive rather than a helpful element for a complex task such as design;
- study mediated synchronous and asynchronous design situations. This involves analyzing the cooperative modes implemented, 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 we frequently use these two approaches. The development of cooperative tools is carried out within a framework of collaboration with computer science researchers, both from university and industry.

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

Participants: Françoise Darses, Thierry Février Quesada.

The MAGIE project addresses the design issues of a cooperative environment, called COOPARENA. 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 have carried out a cognitive ergonomics analysis of the current collaborative situations, 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. Our approach then consisted in translating this model into UML use cases, in close interaction with the system designers. The resulting architecture of the cooperation environment is thereby able to meet the real needs of the Web-based collaborative platform's future users.

In 2004, the last stage of the MAGIE project gave expression to an assessment deliverable of the implemented system [52]. Two main assessments have been carried out, without and with users. The initial iterative and expert assessment led to the second scenario-based usability test. In a realistic test plan, five stakeholders took part in a 2-days interface evaluation. The task observation and user feedback provided performance measurement. The results show three main gaps in the system. The first one is linked to technical problems, the second to unimplemented functionalities and the last to usability problems. Some positive aspects are also noteworthy. A first one is the ecological advantage of this scenario-based methodology. Second is the encouraging character of this asynchronous cooperative groupware's evaluation. Finally, the training and use of this application appear quick and satisfying in an Internet environment.

On the basis of the MAGIE project (October 2001 - November 2003), Thierry Février Quesada is going to defend a doctoral dissertation (planned for spring 2005). His topic is the collective design activity in innovation projects.

4.2.2. MEDIANNOTE: Annotations in engineering design

Participants: Françoise Darses, Françoise Détienne, Sylvie Guibert.

The aim of this study is to characterize the annotations in product design and to define their role in the process of cooperation between various designers. Two studies have been performed to analyse the practice of annotation in design.

The first study has focused on annotation in co-located design meetings. The method chosen for this study has consisted in observing an experimental design engineering situation: four meetings have been video-recorded. The results show that the annotations made during these meetings are both graphic (and not only textual) and figurative (representations of product components). Thus, they are not only deictic. Moreover, the number of annotations varies according to designers' social function and, more precisely, according to the importance of the product area. Lastly, shared work-space is important for cooperative work. Annotations allow members of a group to focus their attention. Situated in the context of the document, they permit a better understanding of it and provide the other designers with a means of reacting via enrichment or evaluation of the solution, and provision of additional knowledge [53].

The second study focuses on annotation in asynchronous design interactions. In this study, quotation (or citation) in on-line discussions of open-source projects is analyzed as an annotation practice. Content analysis of messages composing design-oriented discussions allows us to better understand the semantics of the links between a quotation and the message-part commenting on it.

4.2.3. A socio-cognitive approach of cooperative design in Open-Source Software (OSS)

Participants: Flore Barcellini, Jean-Marie Burkhardt, Françoise Détienne.

Our research question concerns the design processes of an Open-Source Software (OSS) project devoted to the development of a programming language called Python. The designers of Python engage in a particular process called Python Enhancement Proposals (PEPs). PEPs are akin to a design process, called Request For Comments, that has been practised for decades to define standards for the Internet (used, especially, by the Internet Engineering Task Force). PEPs may also be compared to technical review meetings as practised in many corporate and governmental settings. Thus, our refined research 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. Firstly, we are interested in the interaction dynamics of the software designers and implementers. Secondly, we want to understand what we will term the "socio-technical couplings" of the OSS project, i.e., the "statics" that accompanies 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 [50]. This work is performed in collaboration with UC Berkeley.

4.2.4. Software reuse and service-based design

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

Previous empirical studies on design have emphasised the role of memory of past solutions. Design indeed involves the use of both generic knowledge and episodic knowledge about past designs for analogous problems. It thus involves the reuse of past designs. We analyse this reuse from a socio-cognitive viewpoint. According to a purely cognitive approach, reuse involves cognitive mechanisms linked to the problem solving activity. Our socio-cognitive approach accounts for both these phenomena and for reuse linked to cooperation, in particular coordination, and confrontation and integration of viewpoints.

This year, collaboration with the Software Engineering team of 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-centred methods and approaches, and, on the other hand, in the methods and concepts of Software Engineering (architecture, function, service, etc.).

4.2.5. Dynamic aspects of design cognition: Elements for a cognitive model of design

Participant: Willemien Visser.

We have formulated a critical review of cognitive design studies, focusing on activities actually implemented in professional, industrial design projects. This analysis leads to elements for a cognitive model of design that, on the one hand, furthers our understanding of design, and on the other hand, offers a basis for the advancement of professional design education and practice. This research [55] is especially concerned with dynamic aspects of design, that is, it focuses on the activity implemented by designers, especially the cognitive processes and/or strategies they use, rather than with static aspects. First we present the two main competing models of today, that is, the symbolic information-processing approach, represented by Herbert A. Simon and the "situativity" approach, mainly represented by Donald Schön. Next, we present nuances and critiques with respect to both approaches, and complete and integrate them into our own cognitively oriented dynamic approach to design in which, from a cognitive viewpoint, design is considered to be most appropriately characterized as construction of representations.

4.2.6. Viewpoints in design

Participants: Jean-Marie Burkhardt, Françoise Détienne.

The notion of "viewpoint" associated with design activities is here defined as the effects of designers' speciality and possibly their role in the design process on the main constraints and objects that are cognitively favoured. We distinguish the notion of "viewpoint" from that of "representation", classically used in Cognitive Ergonomics. In order to provide design tools, we present an approach to explore the viewpoints of experts that is based on cognitive-discursive analysis and geometric data analysis [38]. Furthermore, a distinction between three types of viewpoints has been made [33]: prescribed viewpoint, discipline-specific viewpoint and integrated viewpoint. This distinction allows us to analyse the dynamics of viewpoint confrontation and the cooperative modes that enable these different viewpoints to be integrated.

4.3. Axis 2: Reflective aspects in design: knowledge management and capitalization

This 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. The topic 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 such approaches have many limitations: loss of knowledge, high implementation costs, reluctance by users to implement the capitalization since its benefits are not instantaneous. The planned solution is to move from a static viewpoint (accumulate knowledge and information) to an approach that is both constructive (assist the individual or group process of knowledge accumulation) and integrated (integrate knowledge accumulation into the main activity itself, in our case design). This is the approach that is pursued in our research activities. In this context, it is also important to analyze the role of meta-cognition in this developmental process and the way to support it.

4.3.1. 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 protocols, which consist in a set of rules resulting from analyzing the scientific literature [51]. When they are faced to unusual situations (that make the application of rules impossible), practitioners can refer to a pluridisciplinary concertation committee (CCP). The objective of this study is to understand how practitioners adapt these rules to respond to unusual situations, and the role of existent resources (protocol and CCP) in knowledge construction and evolution [14][48]. In an initial analysis, 19 practitioners were asked to think aloud while resolving 15 cases involving one or more factors that make impossible strict application of the protocol. Individual allo-confrontation has also been conducted:

practitioners were confronted with colleagues' decisions, and had to comment them [35]. This method leads practitioners to make their knowledge more explicit. Moreover, it constitutes a concrete helpful tool for reflexive activity, allowing knowledge construction and development.

4.3.2. Meta-cognition in collaborative learning

Participants: Françoise Détienne, Laurence Gagnière.

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 in two areas, Collaborative Learning Theory and Meta-cognitive Theory. It is studied in learning situations using a project-based-learning model [45]. This research is performed in collaboration with the Université de Savoie and the Université de Genève.

The originality of our project lies in the integration of two theoretical perspectives in a complementary framework: the impact of meta-cognitive regulation on learning, and the potential role of traces of the learning activity in supporting the regulatory processes. We propose a method of confrontation aiming at supporting conscious awareness of regulation. It consists in confronting learners with the traces of another learner's activity (individually or with a peer-tutoring approach) in order to both make explicit their procedures used to realize the learning task and to improve these procedures. Another important point of this project is to consider the potential of computer environments for encouraging reflection by way of devices that could keep a record of learners' experience.

4.3.3. Mutual learning between users and designers

Participant: Pascal Béguin.

A current field of research considers the continuation of design in usage. Based on activity theory, human instruments are seen as containing components from both artefacts and users' utilization schemes. Users, through their use of artefacts, turn them into instruments. Extending this approach, design can be viewed as a mutual learning process between users and designers [21][17][22][36][18][24][39].

This research question refers to the more general question of how to articulate users' and designers' creativity. Two main approaches have initially been explored. The first one, which consists in ensuring that the creativity of the user's activity will become a source for the designer's activity, leads to the idea that a system crystallizes representations (of functioning, of activities, of work). The second approach, which consists in ensuring that the result of the designer's activity will become a source for the user's activity, calls for a theorization of a system's plasticity and boundaries. A current research plan is centered on articulating the two previous approaches. The main idea is that design is a developmental, dialogical and distributed process of mutual learning between users and designers.

4.4. Axis 3: Methodological aspects

Research on this axis involves work on two methodological aspects: methodologies for the researcher in order to analyze cooperative design situations, and user-centered methodologies for the designer in order to design and evaluate new systems. Progress is to be made on these aspects for the researcher to be 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 and 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 adapted to the aims of the analysis and that can be generalized to any collective design situation. We also need methods to analyse error production mechanisms. Finally, one needs methods to be created for the development of cooperative and interactive design systems. At present, our methodological research activities are focused on innovative virtual-reality based interactive systems.

4.4.1. Analysis methods of collaborative design

Participants: Françoise Darses, Françoise Détienne, Willemien Visser.

Cognitive psychologists and ergonomists have proposed various methods for the analysis of individual verbal protocols, but much less for dialogues in collective work settings. Many professional activities, however, are carried out by people working together through verbal interaction. From a perspective of cognitive ergonomics, we have developed principles for the analysis of collaborative design, amongst which the COMET method [3]. An extension of COMET has been elaborated for the analysis of distant and mediated collaboration [43].

Dialogue analysis has long been the concern of linguistics, especially pragmatic linguistics. In task-oriented design activities, dialogues are said to be cooperative since the partners share a common goal: they have to converge towards agreement concerning a solution. That is why they differ from several other types of dialogues, such as political debates, interviews, chatting, where the aim is not primarily to collaborate towards a common outcome.

In the framework of the MOSAIC project, we have compared analysis methods adopted and results obtained by researchers from cognitive ergonomics and linguistics, the two disciplines collaborating in this project. In addition to the analysis of collaborative activities through people's dialogues, we have also examined their generation and use of external representations, and more specifically their graphico-gestural activities. A graphico-gestural coding has been proposed. Various approaches to analysis have been elaborated, compared and discussed in the framework of the preparation of a book, to be published in 2005 at the PUN (co-edited by F. Détienne & V. Traverso).

4.4.2. Methods for the analysis of error production

Participants: Pierre Falzon, Hélène Faye.

In the 1980's, the automotive industry has supplanted standardized production by custom manufacturing. The organization is, however, still very affected by Taylorism. Operators on assembly lines are confronted with two contradictory logics that oppose flexibility and rigidity. In spite of the repetitive aspect of work, operators make errors that, if not immediately recovered, generate defects that have to be fixed. The purpose of this study [44] is to define the mechanisms of error production, both in relation to work organization and to the nature of work activity. Therefore, a series of interviews will be performed with team leaders in order to formulate a global hypothesis about the causes of error production. Subsequently, a method will be developed enabling to identify the representations that operators have built of their activity.

4.4.3. Methods for the design of new emerging technologies

Participants: Margarita Anastassova, Jean-Marie Burkhardt.

We have continued the research carried out within the framework of an industrial co-operation between the French Atomic Energy Commission (CEA) and Renault S.A.S. On the one hand, we have focused our attention on automobile mechanics' training in the context of recent design evolutions in order to assess the applicability of Augmented Reality (AR) as tutor assistance. The research was based on interviews and video observations. It has shown that tutors' difficulties were mainly related to the explanation of the functioning of vehicle electronics, and to the lack of information provided by vehicle designers [15]. The user interface specifications of the future AR system will be performed using this information. On the other hand, within this research, we have compared interviews and task analysis as two techniques for eliciting end-user needs for emerging technologies. Interviews proved to be more useful for revealing and improving the acceptability of the future emerging technology, while task analysis proved to be particularly useful for revealing utility and usability aspects.

5. Contracts and Grants with Industry

5.1. Grant for PhD Student

Grant for a PhD on Methods for the design of emerging technologies funded by the French Atomic Energy Commission (CEA) and Renault S.A.S. (M. Anastassova).

Grant for a PhD on Error prevention funded by PSA (H. Faye).

6. Other Grants and Activities

6.1. International Collaboration

- **UC Berkeley-Santa Cruz project**:
  Participants: Flore Barcellini, Jean-Marie Burkhardt, Françoise Détienne.
  Collaboration with UC Berkeley and UC Santa Cruz 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).

6.2. European Collaboration

- **Alliance program**:
  Participants: Jean-Marie Burkhardt, Françoise Détienne, Willemien Visser.
  Collaboration on "Applying user-centred 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-centred design in the case of software reuse through service-based engineering tools.
- **Université de Genève**:
  Participants: Françoise Détienne, Laurence Gagnière.
  Collaboration on "Meta-cognition in distant collaborative learning" is currently in progress with Mireille Bétrancourt (TECFA, University of Genève) and Ghislaine Chabert (Université de Savoie).

6.3. National Collaboration

- **Project PERF-RV (RNTL)**:
  Participant: Jean-Marie Burkhardt.
  Collaboration with the INRIA - I3D group, the IRISA - SIAMES group, the Ecole Nationale Supérieure des Mines in Paris (CAO & Robotics group), AFPA (Association pour la formation professionnelle des adultes) and Clarté (Centre Lavallois de Ressources Technologiques) concerning integration of user-centred, cognitive and sensory-motor parameters within an engineering method devoted to designing virtual environments. Two main contributions have been made during the last year: ergonomics studies on usability of different VE configurations [46][49] and participation in engineering a virtual environment for training in the field of metal machining [42][47].
- **Pre-Project AMELIE (Approche Multipdisciplinaire pour l'Ergonomie de La cognition et de l'Interaction en Environnement virtuel immersif) - Interdisciplinary TCAN-CNRS program "Knowledge processing, learning and NTIC"**:
  Participant: Jean-Marie Burkhardt.
  This TCAN pre-project under the responsibility of A. Lecuyer (IRISA-SIAMES) aims to support collaboration with the Ecole Nationale Supérieure des Mines in Paris (CAO & Robotics group) and the Commissariat à l'Energie Atomique (Lab. LIST). Its goal is to develop two new topics in the field of cognitive ergonomics research for the design of better user-centred virtual environments: characterizing the effect of immersion on cognition in real problem-solving tasks, and experimenting the effect of avatar properties on interaction and on systems' usability.

- **Project APLG (Atelier Pédagogique Logiciel Générique) - RIAM program**:
  Participant: Jean-Marie Burkhardt.
  Collaboration with AFPA, Ecole des Mines de Paris, Laboratoire d'Informatique de l'Université du Maine, SNCF, Clarté, Communication & Système. This project aims to specify a generic pedagogical computer-assisted software environment for the development of learning-oriented Virtual Environments. In the first phase of the project, we have analysed user needs in the context of existing virtual environment for training. We are participating in the development of a task-based model to monitor learner behaviours in simulated virtual worlds. In the second phase, we will carry out experiments with the resulting prototype.
- **MEDIANNOTE: Annotation supports and tools in product design. Interdisciplinary CNRS-TCAN program "Knowledge processing, learning and NTIC"**:
  Participants: Flore Barcellini, Jean-Marie Burkhardt, Françoise Darses, Françoise 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 MEDIANNOTE. Four disciplines are represented in this project: mechanical engineering, ergonomics, psychology and computer science. It aims at investigating how argumentation processes can be modelled and supported in collaborative design. The project, notified in September 2003, will end in mid-2005.
- **MAGIE: Cooperative environment for product innovation. RNTL project**:
  Participants: Françoise Darses, Thierry Février Quesada.
  Participants in this project, funded by the RNTL program of the French Ministry of Industry, and led by RENAULT, are 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.
- **PLANS, programme "Cognition spatiale", ACI "Cognitique", Ministère de la Recherche**:
  Participant: Willemien Visser.
  We concluded this year our research on the design of route plans conducted since 1998 in the context of the PLANS research project ("Etude de la planification de parcours en ville") [23].
- **Project "Supervised and automatic acquisition of adaptation knowledge". Interdisciplinary TCAN-CNRS program "Knowledge processing, learning and NTIC"**:
  Participants: Pierre Falzon, Vanina Mollo, Catherine Sauvagnac.
  This TCAN project, conducted under the responsability of A. Napoli (LORIA, Nancy), involves AI researchers, ergonomists (EIFFEL - CNAM) and oncologists (CAV, Nancy). This collaboration, established several years ago, deals with the acquisition, implementation and 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.
- **Collaboration with ICARE-CNRS-Lyon2**:
  Participants: Françoise Darses, Françoise Détienne, Willemien Visser.
  Following the MOSAIC project "Méthodologie d'analyse pour la modélisation de situations coopératives en conception de produit" funded by the "Cognitique" program (Thème: "Cognition, Interactions sociales, Modélisation"') from November 2001 to November 2003, we continue our collaboration with ICARE-CNRS-Lyon2, preparing a collective book on methodologies for the analysis of collaborative design situations (to be published in 2005).
- **Thematic networks and actions**:

  - Action Spécifique CNRS- STIC “Interaction Haptique”. J.-M. Burkhardt (member).
  - Action Spécifique CNRS- STIC "Humain Virtuel". J.-M. Burkhardt (member).
  - Réseau Thématique Pluridisciplinaire “Acceptabilité ergonomie et usages” (RTP STIC). F. Détienne and P. Falzon are members of the executive committee of this network.
  - Réseau Thématique Pluridisciplinaire “Document Numérique”. F. Détienne (member), J.-M. Burkhardt (member).
  - Réseau thématique pluridisciplinaire “Dialogue et interaction”. F. Détienne (member).
  - Réseau Thématique Européen “Langage et Cognition”. F. Détienne (member) & W. Visser (member).

- **ACI “School and Cognitive Science”. Ministry of National Education and Research**
  Participant: André 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 (Australia, France, Germany, Swiss).
- **MultiFiches (self financing)**
  Participant: André Bisseret.
  MultiFiches is an on-line bulletin, published monthly on the Internet and devoted to the domain of multimedia documents and interface design. More than 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. Subscription provides the bulletin by e-mail. A complementary section indicates papers likely to be of interest to practitioners in more specific areas. At present, the writers are André Bisseret (DR emeritus Inria), Mireille Bétrancourt (Professor at Geneva University), Anne Pellegrin (ergonomist at Clips-Multicom) and Nathalie Lépy (Consultant in cognitives sciences).
- **Clips-Multicom - CNRS-Grenoble University**
  Participant: André 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 scientific adviser in cognitive psychology and ergonomics. MultiFiches (was NovaFiches) is now published on the Clips’ site.

7. Dissemination

7.1. Roles in the scientific community

7.1.1. 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 (Travail collaboratif en réseau). Co-organizer: F. Détienne.
- EPIQUE 2005, September, Toulouse (France). Doctoral symposium chairs: F. Darses & F. Détienne. Members of the Program committee: F. Darses, F. Détienne, W. Visser.
- New Approaches to Developmental Studies of Work: A Finnish-French symposium, 25-26 March, Helsinki. Co-organizer (with Y. Engeström): P. Béguin.

7.1.2. Journals' editorial boards

- Design Studies: W. Visser (reviewing).
- Interacting with Computers (IWC): F. Détienne (member of the editorial board), W. Visser (reviewing).
- Le Travail Humain: A. Bisseret (member of the board of consultants); W. Visser (reviewing).
- International Journal of Human Computer Studies (IJHCS): J.-M. Burkhardt (reviewing), F. Détienne (reviewing).
- Document Numérique: F. Détienne (reviewing).
- Empirical Software Engineering: F. Détienne (reviewing)
- CSE Journal: F. Détienne (reviewing).
- Activités, electronic peer review journal: Pascal Béguin (Executive director); Françoise Détienne (reviewing).

7.1.3. Conference Program committees

- RJC-IHM 2004, Rencontres Jeunes Chercheurs en Interaction Homme-Machine, 20-22 October, Lacanau (France). Member of the Program Committee: M. Anastassova.
- IEEE VR'05, International Virtual Reality Conference. Member of the Program committee: J.-M. Burkhardt.
- VRIC 2004 - Virtual Reality International Conference, May 14-16, 2003, Laval (France). Member of the Program committee: J.-M. Burkhardt.
- IEA' 2006, Meeting with diversity in Ergonomics, Maastricht (The Netherlands). Member of the Program committee: P. Béguin.
- IC 2005 (Ingénierie des Connaissances). Member of the Program committee: F. Darses.
- HBiD05, International Workshop on Human Behaviour in Designing, Melbourne (Australia), 14 August 2005. Member of the Program committee: W. Visser.
- PPIG 2004, Carlow (Irlande). Member of the Program committee: F. Détienne.
- PPIG 2005, Brighton (GB). Member of the Program committee: W. Visser.
- CONTEXT'05, Workshop on "Cooperative Systems and Context", Paris, 5 July 2005. Member of the Program committee: F. Détienne.

7.1.4. 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.
- Member of the “Comité de suivi du Département Homme au Travail” of INRS: F. Darses.
- Member of the “Comité de suivi de l’axe Prévention et Conception” of INRS: F. Darses.
- Expert for "Région Champagne Ardennes" postdoctoral applications: 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.
- Programme 2004 “Technologies pour Handicap”, Ministère de l’Education nationale, de l’Enseignement supérieur et de la Recherche: J.-M. Burkhardt (expert).
- Examining members for HDR (M. Baker): F. Détienne.
- Jury member for PhD (P. Lonchampt; Y. Zhu): F. Darses.

7.1.5. 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: Members: J.-M. Burkhardt, F. Darses, F. Détienne.
- SELF. Members: F. Darses, J.-M. Burkhardt.
- SFP (French Psychology Association). Member: A. Bisseret.

7.2. 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.
- J.-M. Burkhardt is senior lecturer at the University of Paris 5.
- V. Mollo teaches at the CNAM (A.T.E.R.) (192h/year).
- Thierry Février Quesada teaches at the CNAM (1/2 poste d’A.T.E.R.) (96h/year).

7.3. Other teaching

- J-M. Burkhardt teached and belonged to the pedagogical comitee at the Ecole d'été du CNRS EIAH "Technologie d'apprentissage et cognition", Autrans, 5 juillet 2004.
- DESS Connaissances Réseaux Communautés, Université Technologique de Troyes. F. Darses (3h/year).
- M. Anastassova teaches at René Descartes University, Psychology Department: TD, Introductory Statistics for 2nd year undergraduate psychology students (15h/year).
- M. Anastassova teaches at Ecole Polytechnique Féminine-Ecole d'Ingénieurs, Information Systems Department: An Introduction to the Ergonomics of Augmented Reality for 4th year engineering students (1h30/year).

7.4. Invited talks and Scientific popularization

- **W. Visser**
  - Between 27/08/04 and 17/09/04, she has been invited by John Gero (Professor of Design Science, Co-Director of the Key Centre of Design Computing and Cognition, and Associate Dean for Research) as a Visiting Scholar to the Faculty of Architecture of the University of Sydney (Australia).
  - "A cognitive ergonomics view of design: Design as a particular type of problem". Invited talk at the Research seminar of the Key Centre of Design Computing and Cognition, Faculty of Architecture of the University of Sydney (Australia), 8/09/04.
  - "A cognitive ergonomics view of design: Design as a particular type of activity". Invited talk at the Research seminar of the Key Centre of Design Computing and Cognition, Faculty of Architecture of the University of Sydney (Australia), 15/09/04.
  - "Design cognition: a cognitive ergonomcs view". Invited talk at the ICT (Information & Communication Technology) center's group at CSIRO (Australia's Commonwealth Scientific and Industrial Research Organisation), Macqarie Univerity, Sydney (Australia), 10/09/04.
- **Françoise Détienne**
  - Articulation des dimensions graphico-gestuelle et verbale dans l'analyse de la conception collaborative. Séminaire "Langage et Cognition", Cognitique, Toulouse, 9-10 Septembre 2004.
- **Jean-Marie Burkhardt**
  - L'Ergonomie dans la conception des technologies et des situations d'apprentissage. 2nde Ecole d'été CNRS EIAH "Technologie d'apprentissage et cognition", Autrans, 5 juillet 2004.
  - La mise au point de dispositifs haptiques et visuo-haptiques: une approche de l'évaluation adaptée de la psychophysique. AS Haptique du CNRS, INRIA Grenoble, 10 juin 2004.
  - Les environnements virtuels en ergonomie. Journée de travail INRS Prévention et conception, INRS, Paris, 3 juin 2004.
  - Modèles psychologiques et informatiques du comportement humain. Communication présentée aux journées de l'Association Française d'Informatique Graphique, Université de Champagne-Ardennes, Reims, 17-18 juin 2004.
  - Modèles psychologiques et informatiques du comportement "Humain Virtuel", groupe Modèles du comportement, Ecole des Mines, Paris, 13 janvier 2004.

7.5. Participation in scientific events

Ecole d'été du GDR "Technologies de l'information et de la communication", thème "TIC et cognition", 5-10 septembre 2004, Carry-le-rouet; Flore Barcellini (participation).

XXXIX-ème Congrès de la SELF, "Ergonomie et normalisation", 15-17 septembre, 2004, Genève: Hélène Faye (communication); Vanina Mollo (communication).

VRIC 2004 - International Virtual Reality Conference, May 14-16, 2003, Laval (France). J.-M. Burkhardt (communication).

4S conference - Paris, 26-29 août. J.-M. Burkhardt & F. Détienne (participation).

CSCW 2004 - Chicago, US, 6-10 November. F. Barcellini, J.-M. Burkhardt & F. Détienne (participation).

Workshop "The Distributed Collective Practices: Building New Directions for Infrastructural Studies", CSCW 2004, Chicago, US, 6 November. F. Barcellini, J.-M. Burkhardt & F. Détienne (communication).

Journée Thématique "L'ergonomie comme vecteur d'innovation", June 10, 2004, ENSAM, Paris. Participation: T. Février Quesada.

Journée scientifique de l'ARCo, "Questions et méthodes pour une ergonomie des technologies cognitives", November 19, 2004, ESPCI, Paris. T. Février Quesada, F. Détienne, W. Visser (participation); P. Falzon (communication).

COOP 2004, Sixth International Conference on the Design of Cooperative Systems, Hyères, 11-14 May. F. Détienne (communication); F. Darses (participation).

Journée d'étude SFP "Psychologie de la communication: interactions, stratégies cognitives et discursives", Paris, October 9-10. F. Détienne (participation).

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