Instruments for Collective Design in a Professional Context: Digital Format or New Processes ?

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Abstract—**This article reports on different collective practices and their instruments observed in the context of professional design activities. Based on interviews and in situ observations of customs in six architecture, engineering, and design agencies, it shows the diversity of typologies of collective activity, identifies the main factors of collaboration, and concludes on the needs for the instrumentation of professional practice. Is it a matter of building higher and higher performance digital formats for a shared modeling of the project or to lean instead towards the creation of new processes of group management and remote work by several people? From the results of this observation of collective practices in design, this article allows one to highlight the real needs of the agencies and to help their teamwork. These needs consist of: 1) facilitating reflection, 2) managing changing dynamics, 3) allowing the reflective exploration by several persons between space and time, and finally 4) guaranteeing a common progressive and exploratory strategy between actors whose expertise and commitment differ within the same process.**

Keywords-collaborative design; professional practice; observations; tools and processes.

I. INTRODUCTION

Faced with competition, tight deadlines for delivery, and qualitative and regulatory demands, which are increasingly complicated and difficult, the architectural and design agencies are innovating concerning interdisciplinary approaches, associating different skills that are necessary for the realization of the project [1][2]. Nowadays, the designer does not work alone on a project but with other experts, bringing together architects, engineers, designers, sociologists, economists, etc. The process has thus become collective, reuniting different skills which must be applied starting with the first phases of the project design.

Several researchers are indeed interested in group design and have proposed tools to facilitate the sharing of communication [3][4]. Since the development of the Internet, new technologies have been conceived, stemming from the CSCW (Computer-Supported Cooperative Work) scientific field to support group work [5].

Called groupware, these tools are used today to guarantee the coordination, to manage the tasks and to enable the cooperation between several actors separated geographically. But most of them only partially meet the specific needs of the agencies and their design processes whose synchronous sharing of annotations, graphic interactions, and information management is essential [6]. This sharing is even more indispensable in daily activity because of qualitative requirements and increasingly coercive regulations. In addition, most of these agencies are faced with strong competition and tighter and tighter deadlines even though their activities involve different skills due to design, architecture, engineering, ecology, ergonometry, sociology, etc.

This is why it seems essential to clarify the specificities of the real activity of design in agencies, in terms of tools as well as work methods, before even beginning to compare the computer support and/or solving the problems that can be linked to it. This choice is based on the working hypothesis where the project considers design as a unique and complicated activity gathering together different viewpoints and having to answer to several choices, problems and constraints linked to the project. Our study is based on an analytic approach inspired by the methodological approach of "action research" [7], which consists in going into the field in order to get directly into a real industrial context to observe and study some work tools and procedures.

This article presents in sections II, III, and IV, the latest developments and the question of research that are the framework of our study and the methodology on which it is based. Section V follows by exposing different real practices in architectural, engineering and design agencies, which present the particularity of leaning on a collective, multidisciplinary, and multi-sites activity. Their practices, procedures and tools are put forward in section VI, so as to point out, through the diversity of observed collective situations, the collaborative operations put into practice, as well as the different co-spaces that make up their work environment.

II. LATEST DEVELOPMENTS AND RESEARCH QUESTIONS

Collective activity has been the object of many research projects. It is usually compared to individual activity [8] and may take several forms depending on the field in which it is examined. To define the different forms of collective activity, some researchers have distinguished between them according to the objectives sought by the protagonists of the project and the specificity of the tools used to work in groups [9][10]. Other researchers have highlighted the influence of the number of actors and their hierarchical relations in their activities [2][5][11][12]. Others have shown that collective activities change according to the task, the kind of exchange,

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and the tools used by the actors to work together [13][14][15]. Others have specified the collective activity according to the time reference and the space of exchange, and they have even proposed a classification of the tools, which allows them to support this work in groups (groupware) via the time/space matrix first set up by Johansen [16] and then repeated by Ellis, Gibbs and Rein [17], and Gaver [18]. Other researchers have also proposed other kinds of classification of groupware according to their objectives in the conception: cooperation, coordination or communication [19].

Faced with this abundance of classifications of collective activities and their tools, our beginning premise is to focus our research neither on the comparison of performances of computer-assisted design nor on the solution to their problems. The primary aim of our study is to clarify the collective design activities set up in the agencies by simply relating their specificities and their real needs without preconceptions or the imposition of any tool or group-work method.

III. RESEARCH FRAMEWORK

This work fits partially in the frame of the program "Creation: actors, objects and contexts". Called CoCreA and financed by the National Agency for Research in France, this project groups 3 research laboratories in different fields (Limsi-CNRS, Map-Maacc and LUCID-ULg). Its objective is the development of new understanding of creative collaboration in architecture, examining the customs, their tools for sharing, as well as the implications in the actual design activities [20]. This study framework has enabled us to investigate the professional context on which our research question is based, examining the actual collective design activities and their need for assistance.

IV. METHODOLOGY

For the study of collective design activities, several protocols have been set up. According to Ericsson and Simon [21], two complimentary trends of intervention and analysis are to be distinguished between:

- The "retrospective protocols," which concern the study of projects regardless of the situation in which they evolve;
- and the "concurrent protocols," which take an interest in the analysis of the real activity, taking into account the particularity of the designers, their tasks, and the environment in which they work and collaborate.

Our study joins more with the second trend and is more particularly based on the "action research" methodological approach, whose first objective is to examine the practices in their actual context, and group together action and reflection, theory and practice, with the participation of individuals and their communities [22]. Based on ethnographical studies and faced with the complexity of collective design activity, we have chosen this approach because, according to Brydon-Miller et al. [7], it is better suited to specify the action and the know-how of the experts in their context: between actors, social hierarchy, the urgency of the reports, regulations, procedures to be respected, deadlines to meet, diversities of situations in which the objects to be designed evolve and their protagonists, etc..

In order to build up a specific knowledge of this activity, we have been thus based on on-site observations and interviews. This data involves several agencies having a collective design activity and meeting the same criteria: they are multi-disciplinary, multi-site and/or work with other design agencies, and declare that they have set up real collaborative practices in their activity (architecture, engineering, or design agencies).

We have been able to accumulate observations and interviews from different meetings of operators working in the agencies. We have then organized our analytic basis on 5 themes:

- The way the agency functions: the methods and habits of the agency, the different sectors that it deals with, the operators that it brings together depending on their expertise, competencies, and knowledge in the project;
- the kinds of collaboration and the characteristics of the collective activities: the face-to-face or remote collaborative practices of the agency, inter-agency collaboration or collaboration with external actors (sub-contractors, consultants, general companies, etc.), the kinds of meetings that they set up, etc.;
- the tools and procedures of exchange and their roles in the collaboration and in the design process: in this case we mainly based our research on the cases of remote collaboration highlighting the kind of project concerned, the tools used, the procedures and methods chosen or adopted to work together remotely, as well as the consequences these practices have on the design methods;
- the exchange methods and principally, the graphic representation: the role of the graphic representation as object between the collaborators, the tools used to share, the annotation and/or modification of these representations, etc.;
- the expectations and perspectives: the problems that designers raise during their remote collaborative activities and their suggestions for ideal instrumentation in order to efficiently aid the face-to-face or remote collaboration in design activities.

These corpus have thus enabled us to identify, on one hand, the different cognitive operations put into play and, on the other hand, to highlight some procedures, methods and tools set up in these practices. Our objective is to identify the means and modes of collaboration used by the designers in the preliminary phases of the project.

V. ANALYSIS COMPARED OF THE COLLECTIVE ACTIVITIES IN AGENCIES

Our observations and interviews were used to construct a chart of collective activities observed in the 6 following agencies: the AIA agency (between Paris, Nantes and Lyon), ORA-ITO (interviews of project leaders in Paris), Mikado

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Architecture (Lille), Art & Build (observations in the main agency in Brussels), Architecture Studio (Paris), and Gehry Partners (at Gehry Technologies in Paris). This corpus, in its diversity, enabled us to highlight several kinds of collective activity, methods and tools used to be able to work with several persons. The kinds which are shown are based principally on the dichotomy Space/Time as set up by Johansen [16] in the field of CSCW; see table 1. We observe several recurring tools, such as face-to-face meetings, or by telephone, videoconference, e-mails, post-its, internal network exchanges, electronic plan boxes, etc.

TABLE I. SYNTHESIS OF GROUPWARE USED IN AGENCIES FOR GROUPWORK [16]

Collaborative work	**Same time**	**Different times**
Same place	Syncronous : real co-attendance meeting	Asynchronous + delayed : - post-it™ - email - file server
Different places	Synchronous + distributed - phone call - visioconference - screen sharing	Asynchronous + distributed: - mail and email - file server - wiki

Nevertheless, differences in the practices have also been observed. These differences also depend on the project and the degree of complexity that is involved. They show a range of kinds of collective activities and a diversity of solutions, sometimes pre-existent and often put in place by diverse procedures or by diversion of tools. Some of these tools and procedures are the same in all of the agencies such as the mail or the establishment of a graphic chart. But particular cases are also highlighted by the specific activity of each agency. We synthesize, in the following section, the principal diversions which are set up to respond to, as well as possible, the constraints of distance and/or the differences of the teams that have to work together in the context of project design.

A. The case of AIA

In the context of Design/Construction cooperation, the agency has had to use a system of computer screen sharing to manage their regular inter-agency meetings. In the observed situation, this tool is coupled with a telephone, hooked up to a speaker, to speak over the distance. The collaborators can thus see, at the same time, the same image, all the while having the possibility to point to spaces (via the cursor) and share some annotations (realized as well as possible via a mouse). The collaborators can consider, comment or annotate the documents shared by one of the two designers. The latter assumes the role of "chairperson" because he is the only one to decide which space can be shared and used by all players (see VI.C : as We-space) or kept in hidden notes as private space (I-space).

To manage the diversity of actors in the same project and their possible replacements, AIA has set up a procedure involving the updating of a "thematic notebook". This "thematic notebook" serves as a point of reference to everyone joining the group on the way. It is a sort of project logbook which enables everyone to understand different decisions taken in the course of the project, its evolution, and references. Ranking the data to be taken into account and essentially serving the construction of a common ground, it shows the work done during the conception, and makes the choices of the team and the architects' organizational schemes explicit in relation to the project. It also regroups technical notes, and the minutes of the meetings which can also serve as a support for the contracting authority.

B. The case of ORA-ITO

Under the direction of Ora-ito, the agency makes people with different skills intervene: industrial designers, graphic designers, architects, etc. It also works very closely with several industrialists for the manufacturing of the products, integrating even the packaging and the shops which expose them. In spite of the multi-disciplinary activity involving several protagonists found on different sites, this agency has clearly expressed its lack of interest for remote collaboration activities. "If we need to work together, it is enough to gather everyone around a table" declares one of the project-leaders of the agency.

C. MIKADO Architecture

To be able to devise a complicated cooperation with tight deadlines, the Mikado agency is associated with other external agencies (one in Paris and the other in London). In this particular situation the actors do not have the opportunity to get together often enough to work together on the project. They have thus chosen an online game of virtual reality (like Second life®). Each of the actors invented an avatar to create a model shared online for their project in this virtual space that they manipulate together over a distance. Each time a problem comes up, they get in contact by telephone, then they get connected, each one via his computer, to work together, directly on the shared virtual model. These actors have had to face many difficulties because the 3D model manipulating tools offered by the game remain too limited and basic to assume efficient oral and graphical exchanges in real time.

D. ART & BUILD

In the framework of designing a collective living project which is close to one of branch offices of the head office Art & Build, the two sites use a new system to share graphic annotations in real time, called Collaborative Digital Studio [23]. Developed in the LUCID Laboratory of the University of Liège, this system has been loaned to the enterprise to support their activity of inter-agency remote design. In contrast with the experience of Mikado, Art & Build is satisfied with the use of this new communication and remote collaboration system. At any time of the day, they can call, get connected at a distance and work together in real time on the graphic documents that they have just produced. In this way they can better coordinate. Nevertheless, the observation of their use also shows that the actors do not make use of this system as much as supposed, because, in fact, the system has

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not changed the frequency of the trips made by the collaborators between one site of the agency and the other. Rather it enables other kinds of meetings that are more spontaneous and shorter. According to the users, this is not due to bad understanding or appropriation of the system, but rather to a habit which is not yet part of their daily routine: "We know that the system was there, but we forget to use it each time that we have to communicate or work with the other agency: the reflex is to take the train and go there directly…"

E. Architecture Studio

The particularity of this agency is that the designers have different nationalities with different architectural cultures. To manage this kind of situation, all of the project teams must accept the suggestions from the others and adapt to the multicultural differences in the name of the project. In this context, the agency is also faced with language and reference-synchronization problems, and the knowledge of the others. To try to eliminate the effects of hierarchy and to let everyone express themselves as they please, the agency has set up a procedure based on the codification of shared drawings according to their colors. In this way four kinds of drawings have been defined and codified: 1/the red drawing for all of the existing data that is important to keep in mind for the project design: it cannot be modified, nor questioned by the designers; it represents the only fixed and certified element in the project; 2/ the green drawing contains the remainder of the elements that compose the project such as the walls, the closets, the opening, etc.; 3/ the black drawing is for the elements that concern the existing plan except those already put in the red drawing; 4/ the blue drawing which transcribes all the annotations and information about constraints to be integrated in the project design. According to the designers, even the traces left by the scratches of a razorblade on the tracing paper are important because they give an idea of the history of the project. This way, all the drawings represent the basis of the design of the model and are the result of collective decisions managed by this kind of procedure.

As the agency also works in collaboration with other branch offices in different time zones, it has had to invent a system to share digital annotations in real time. It had set up a system diverted from shared screen projection that it threw together as well as possible with the tools.

F. Gehry Partners

Working with non-standard shapes for the technical design and the construction of the Louis Vuitton Foundation pavilion, the Gehry Partners agency uses programs originally developed for the aeronautic sector [24]. In this context, the team in Los Angeles and the team in Paris have given themselves 2 distinct roles in the design process: the former mostly takes care of the formal and functional aspects of the project, the latter focuses more specifically on the technical aspects and the structural calculations of the building. The first 3D model was made by the Los Angeles team. It serves as a digital model so that the head architect, F.O Gehry, can refine and transform his project according to choices related to his own pertinences. Then the team in Paris takes back the first model, extracts the geometry and builds a new model with defined and shared parameters in which they insert their choices for the structure and the technical calculations of the building. This second model was developed from the moments of collaboration in the presence of the different engineers and architects from Paris who work with other design and calculation tools before integrating their decisions in the model with the shared parameters. This model is then approved by the chief coordinator, who is also in Paris, and then put in the 3D model with the shared parameters. It is not only visible by the whole team in Paris, but also accessible and consultable in Los Angeles. The head agency can also survey the evolution of the technical model at any time and distance. From the first transformation or modification of the building, the head of the project can decide to back up or to transform the model so that it suits him. The shared program of the 3D model serves more to validate choices, to evaluate them in relation to decisions inserted in the model by other people, and to coordinate the team work rather than a collaborative design, to the management of the negotiation and the questioning by consensus of the project.

VI. DIVERSITY OF COLLECTIVE SITUATIONS VS. NEED FOR ADEQUATE TOOLS: BETWEEN TOOLS AND PROCEDURES

The following observations enable the identification of the principal concepts documenting the question of remote collaboration in an actual situation of architectural design, including:

- The kinds of collective activities: between collaboration and cooperation,
- the collective operations: between design, collaboration and tools,
- the work co-spaces: I-space, We-space, and Space-between.

These observations highlight the need for the construction of common referential operatives faced with the diversity of each of these ideas as well as the part played by negotiation, evaluation and the questioning by consensus in the process of collective design. Is this need better orchestrated by digital supports which are more and more reliable for shared establishment of a project model, or by setting up of new group management practices and work done by several people?

A. Diversity of the shape of collective activities

To respond to the complexity of a project, several regular or spontaneous meetings are organized. Some concern the organization of the agency and its branch offices, others, deal more specifically with the project. Regular meetings are essential for the organization of the group and its coordination. They enable the collective decision-making and choices concerning the project and to synchronize each one's tasks in the design process. These meetings give control, coordination and steering of the collective design activity. They tend to reduce misunderstandings and build the shared group consciousness, which is necessary in any collaborative situation.

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However, to respond rapidly to some constraints of the project, the designers also resort to spontaneous meetings. These meetings usually take place in co-presence, with face-to-face discussion about certain aspects not mentioned in the formal meetings. Meetings are also held over distances via videoconference systems, screen-sharing or diversion of a group of tools (for example on-line virtual reality games used by Mikado). These meetings generally try to respond to an immediate need to deal with questions in common. They mark the milestones of the project: (1) moments when the designers collaborate, think and make decisions, by negotiation and consensus about choices which concern either the project or the organization of the group, and (2) moments when each one focuses on their own tasks for the same shared objective. This passage from a moment of collaboration to a moment of cooperation implies, on one hand, dynamics of learning (which tend to gradually cross during the exchanges [25]), and missions to share and divide between different actors, but also communication tools in common. On the other hand, the complementarity of the moments when the designers cooperate and other moments when they collaborate, just as the passages from one to another are important to manage during collective activities (see figure 1).

When they cooperate, the designers do not need to see each other, each one doing his task then waiting for the validation (or not) from the coordinator. When they collaborate, the designers synchronize their knowledge (cognitive synchronization) and try to build a mutual consciousness of their activities, tasks and contexts to respond jointly to the project needs [26]. Nevertheless, this mutual consciousness implies a sharing of knowledge related to the context of the project design and to the tasks of the actors through a cognitive as well as temporal-operational [27] synchronization.

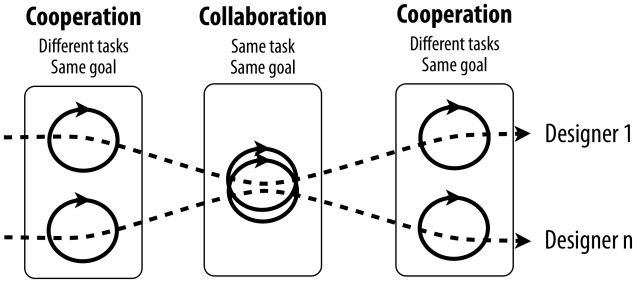

Figure 1. Collective design process

It is important that the tools take into account these passages between the different kinds of collective activities in the design. In fact, the actors need to structure their activity and their tasks according to the project needs and its level of complexity. Some parameters, as important as the cognitive synchronization or the need to put together a common referential operative, are only partially managed by the groupware currently used in the agencies. This is why the coordinators have such a dominating place in the process. Also, to partially meet these needs, the designers are often obliged to divert a group of tools or call on production groupware which often proves to be not adapted to the preliminary design phases.

B. Diversity of collective operations

Based on observations of these different collective design activities, our analysis, based on the field of applied architecturology [28], have shown that specific cognitive operations are put into play. Some operations are linked to the design itself of the project, others are linked to collaboration strategies and the work done together and others are specifically linked to the appropriation and use of the tool which is used to work together. If we focus only on the operations linked to collective activity, we enumerate several categories [29]: pooling, interpretation, discussion / evaluation / reconsideration, automation / cooperation, validation, conflict solving, decision / prescription, building group work strategy / coordination. Putting these operations into play is transmitted through speech as well as by drawing, regardless of the kinds of collective activities in which they intervene: regular or spontaneous meetings, taking place face-to-face or over a distance, simultaneously or not.

During these meetings, the actors share graphical representations which can have three roles: that of mediation, of translation and/or representation [9]. These representations are considered either as a “closed” intermediary object, which cannot be argued with or modified, or as an “open” object, which can be discussed and questioned during the meetings. This intermediate object is transformed and evolves between the moments of collaboration and the moments of cooperation. The shift from one moment to another demands that the representations must be at least standardized, adjustable and multipurpose in order to be understood by the other collaborators. It is in this way that the collective operations such as: pooling, interpretation, discussion / questioning the decision / instructions are primordial in the choice of tools or procedures to be set up for collaborating. Different examples coming from our observations can be cited:

- Pooling has been enabled by the codification of the colors in the activity of Architecture Studio, thus backing up the representation between collaborators by sharing open intermediary objects;
- the interpretation has been enabled by sharing a 3D model fixed between remote Gehry collaborators, thus supporting the translation between the collaborators by the sharing of closed intermediary objects;
- the discussion / questioning has been enabled by the sharing of a 3D model built via virtual space between remote collaborators of MIKADO, thus supporting the mediation by the sharing of open intermediary objects;
- the decision / instructions have been enabled by a thematic notebook set up by the AIA, thus supporting the representation between the collaborators through the sharing of closed intermediary objects.

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C. Diversity of working co-spaces

The idea of space is decisive in collective design activities [30]. In the case of cooperative activity, it is easier to work at a distance than in the case of collaborative activity where the sharing of space and the context of the work in real time proves to be more necessary. This shared work space is perhaps not physical, in rooms or in offices: it can also concern hybrid spaces, bringing together at the same time virtual and physical environments. This hybrid space implies the setting up of intermediary work spaces that are short-lived and that are created according to the needs of the designers and their negotiation strategies.

We suggest, in figure 2, to distinguish three kinds of intermediary space composing the joint work environment [31]: the I-space (representing the personal work space), the We-space (representing the shared work space) and the Space-Between (representing the work space built between designers separated from the group).

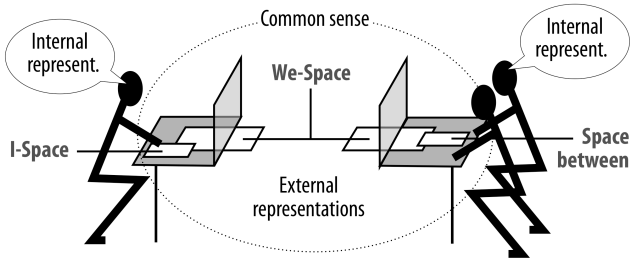

Figure 2. I-Space, We-Space and Space-between as intermediary work spaces.

The role assigned by the designers to this or that space can change according to the objectives, needs, choices related to the negotiation process and the arguments between the actors. The relation between the individual and the situation in which he evolves is emphasized - cognition situated [32] – by the relation that the actor has with his space, his tools and the other actors who surround him in a remote collaborative environment. If, for strategic reasons, a designer decides not to discuss a solution with the collaborator in the same office, the shared document becomes a private space, or a Space-between.

Thus it is important that the intermediary tool offers this flexibility between the intermediary spaces. In fact, the designers need to structure their information and their display interface, to be able to navigate easily from one document to another and to create work methods that are adapted to their situation. All these parameters are only partially managed by the screen sharing system (as that which is used at AIA to respond to support design/construction collaboration) as it imposes the designation of a "chairperson" who is the only one who can make manipulations on his screen. The collaborators, being only observers, can just annotate the documents and point to certain zones of the work, only if the chairperson enables them to. Thus, this tool adds value to the individuality of the designer/chairperson at the expense of equal sharing between collaborators. This even has an influence on the negotiation process, evaluation, and questioning by consensus between the collaborators. In fact, when the actors get together for a meeting (from a distance or face-to-face), each one arrives with his/her solutions, points of view, and references (I-Space) that he shows to his collaborators. He/she evokes them during the meeting (We-Space), according to the themes that have already been defined either by the circulation of the agenda, or just simply by a demand (formal or not) generally provoked by the project director about a particular problem. The agenda is a classic procedure but is necessary to guarantee the mutual awareness of each one's tasks and the evolution of their role in the process. During these meetings, according to the project or objectives, negotiations take place between the actors to defend their choices or their own objectives. This exchange of viewpoints is a part of the construction of new shared knowledge to result in a compromise between the actors and their common objective. The different propositions generated are often followed by opinions and arguments from one group and another to justify them or to put forward others. Taking different forms – analytical, comparative or analogic [33] – these evaluations take place at key moments in the design making it possible to develop an iterative process of collaboration and to introduce the next subject to deal with. They are dictated by permanent research of compromise, where three categories of interaction are revealed [26]:

- Interactions dedicated to the collaborative design process of the architectural object – linked to an awareness activity (orientation of the building, its dimensions, the site and the functionality, etc.);
- interactions dedicated to the situation of the collaboration – linked to social awareness (definition of the design context, work procedures, sharing methods, communication tools, etc.);
- interactions dedicated to the actors – linked to action awareness (knowledge of the actors, experience, competence, logical actions, roles, tasks, organization, coordination, etc.).

Most of the existing tools manage one or another of the operations used in negotiation, evaluation, or questioning by consensus without real assistance enabling them to be linked. Let's take the example of the Chantier.com tool [34] set up by AIA to present an entry point on the Internet to exchange documents between different project actors. The uploading and downloading of the files are the principal function defining this space. However, the accumulation of this data and certain versions can lead to confusion because, in the observed version, there is no real hierarchy between the data except for their listing and their date of insertion in the site. They also create complications through a lack of coherence between the tools and the way teams function. Just like this example, most of the groupware currently used in the agencies, only partially enable synchrony between the actors collaborating from a distance, increasing the misunderstanding between them and decreasing their interactions. Nevertheless, taking charge of the heterogeneity between the actors, their specialties, and their references can be managed by procedures and, sometimes, imposed by norms. The procedures are often unique to the group of

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designers according to their tasks, their pertinences, preferences, knowledge or personal experience. When they are imposed according to the norms, they must also allow for some gradual evolution of the collaborative process to not restrict the group. The organization of the data to be treated in a hierarchy, by the actors, during the project is also necessary to manage the negotiation and evolution process during the collaborations. Deciding on the level of priority of one point of view or another enables one to consider each criterion in the design and to decide to reject, or to suspend the incompatibility of others.

VII. CONCLUSION.

This report on practices has allowed us to qualify the context in which different groupwares, group support and strategy are integrated and set up by the agencies in order to aim for better management of knowledge and more efficient and productive interaction. It is clear that there are no methods or tools that are perfectly adapted to the context, especially in the case of synchronous and remote collaboration. The research attempts that develop specific tools for collective activity are not yet compatible with the constraints and the reality of the practice in the agency. These discrepancies can be explained because the tools are often developed for other activity sectors without really focusing on the specificities of each of them. And in the case where they claim to be adapted to a particular design activity, they are only adapted to the advanced phases of the process where the choices concerning the project have been previously defined by the group of actors.

This way, we can conclude by listing the need of agencies to go from tools that are thrown together towards the construction of strategies and procedures which enable:

- The management of the processes of negotiation, evaluation, calling into question the first phases of design: the objective being to encourage reflection;
- to take into account the multiplication of exchange places and the passage between them (I-Space, We-Space, Space-Between): the objective being to manage a dynamic in motion;
- to enable the diversity of representations and their transformations from one format to another: the objective being to enable reflexive exploration;
- to assure the synchrony between actors collaborating remotely, as well as the passage between moments of collaboration and moments of necessary cooperation in the current activities of the agencies: the objective being to allow a strategy that evolves, explores, and is flexible implying the object to be planned, the group and the tool.

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