Digital Cooperative Studio 07-08

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Abstract

Teaching cooperation-related issues to AEC (Architecture, Engineering and Construction) students is a major stake nowadays. There are many reasons for that: construction projects become more and more complex and cooperation practices are evolving in both organizational and IT-based ways. It is notably for these reasons that the issue of IT is addressed in most of the AEC-oriented schools and universities. Traditionally IT is taught to support the tasks of each specific construction field (e.g. CAD for architects, simulation tools for static engineers etc.). The Digital Cooperative Studio, presented in this article, considers IT as a support to cooperation and especially its communication and coordination dimensions. Moreover, we describe here a living lab involving students, teachers and researchers. This strong link between research and teaching allows both the students to be "analysts" of their real project situations and the researchers to experiment their development in real project situations.

Keywords

Co-design, Cooperation, Education, AEC, Virtual Studio, IT-services

1 Introduction

Construction projects become more and more complex, involve many actors, who are heterogeneous and work together for short-time periods. The professional practices are constantly evolving. The increasing number of actors involved in projects and the new needs of expertises are changing the cooperation practices in an organizational way. Moreover, these new practices are often based on the benefits of IT. New ways of working are enabled, such as representing the project or simulating its different aspects, but also supporting the cooperation practices through more transparent, described and managed flows of tasks and documents.

In the AEC educational curriculums, teamwork exists and students are often placed in collective situations, working in group on architectural/urban project design. These situations are close to the ones existing for example in architecture agencies, where some collaborators have to share tasks and documents to answer a client's demand. This form of collective working is generally driven by hierarchy and procedures. But this type of group work is too limited and we think that students are not enough prepared to the collective and multi-disciplinary dimensions of construction projects. In such situations heterogeneous actors have to work together in unpredictable and changing environments. Furthermore, the participants of projects are often distant and they work at different time periods.

In this context, the use of IT tools is necessary to simply enable the collective work. Nowadays architecture and engineering schools students are familiar with numerous IT tools, useful to design, simulate and merely represent their architectural projects. But, once more, we notice that they are not aware of IT-based tools supporting cooperation between participants of a project (i.e. groupware tools).

For all these reasons we setup the Digital Cooperative Studio: an experiment of collective architectural design between distant teams of students. In this article we describe the 07-08 SDC aims, the organization of students' work and the IT-tools set up to enable cooperation activities.

2   Digital Cooperative Studio

2.1   SDC - Motivations and history

The Cooperative Digital Studio (SDC) is a pedagogical experiment aiming to bring Master's students in a cooperative architectural project. For some years, at the Architecture School of Nancy, the initial objectives of our experiments are to sensitize the students to the cooperation issues in Architecture [Bignon et al. 2007; Kubicki et al. 2004]. Our approach is closer to other cooperative "virtual studios" [Forgber and Russel 1999; Kvan 2001; Van Leeuwen et al. 2005]. It differs from other ones, which are focused on IT tools for specific design activities (architectural modeling tools) or on prospective use of virtual design worlds [Brown et al. 2001].

SDC could be characterized by a strong link between research and pedagogy. The associated research laboratories carry out different kind of research in the fields of design and cooperation:

- Theoretical research (MAP CRAI, LuciD Group) aiming to describe a "context of cooperation" in Architecture, Engineering and Construction projects, to understand the organizational/sociological issues related to cooperation and also to design new assistance tools and new visualizations modes.

- Applied research (Public Research Centre Henri Tudor) through the development and experiment of innovative IT-services directly specified with the practitioners (future users).

In this context the relationships between students and researchers are very rich. On the one hand, teachers/researchers try to impart to the students the basic knowledge to understand, analyze and improve their cooperative activities. They guide also to the use of cooperation-support tools made available during the project. On the other hand the students, through their use of tools, bring to the researchers real project situations to experiment the prototype tools, still under development.

2.2   A France/Belgium/Luxembourg Cooperation

In 2007-2008 the Digital Cooperative Studio was the result of an association between two academic institutions (Architecture School of Nancy & University of Liège) and three research laboratories from France (CRAI), Belgium (LuciD Group) and Luxembourg (Public Research Centre Henri Tudor). The educational curriculums are close: a Master Degree[1] in Nancy and 2nd/3rd year of Architecture/Engineering studies[2] in Liège.

These partners are complementary by the study curriculum but also by the research projects that they carry out, both in the topics of Computer-Aided Architectural Design and of Assistance to Cooperative Activities in Construction.

2.3   2007-2008 Cooperative Studio: the environmental issue to foster cooperation

The 07-08 cooperative studio involved 29 students from Nancy and Liège. The architectural project consisted in designing a "House of Environment" (3000 m^2), comprising a conference centre, a library and a cafeteria. The site was in Nancy, France.

The environmental issue was chosen by the pedagogical team for many reasons. Firstly, it is a contemporary topic, emerging from current considerations (e.g. on climate changes, energy savings etc.), which is attractive for future architects and engineers. Secondly, this issue was interesting in stimulating cooperation between students. In fact sustainability in building should only be raised by collaborative teams of experts, bringing their forces together to address its numerous dimensions. Finally, in their master's curriculums, the students acquired competencies

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[1] http://modelisation.nancy.archi.fr

[2] http://progcours.ulg.ac.be/cocoon/en/programmes/AIICAR01.html

in diverse computer simulations. It was interesting to re-use it to perform sustainability assessments on the projects: 3D modeling, natural/artificial light evaluation and energy efficiency.

3 Organization of work

In the existing architecture and civil engineering curriculums, students need sometimes to work in groups with their colleagues but they are seldom confronted to distant cooperation situations involving other fields of competencies. We think that they have to be prepared to such situations, very common in the everyday practices in AEC.

3.1 A cooperative process

In 2007-2008, SDC took place from October to December, during 13 weeks. In order to perform the work and to realize the project, a cooperative process was defined with the students. This exercise was based on the main concepts related to cooperative projects taught in the theoretical courses.
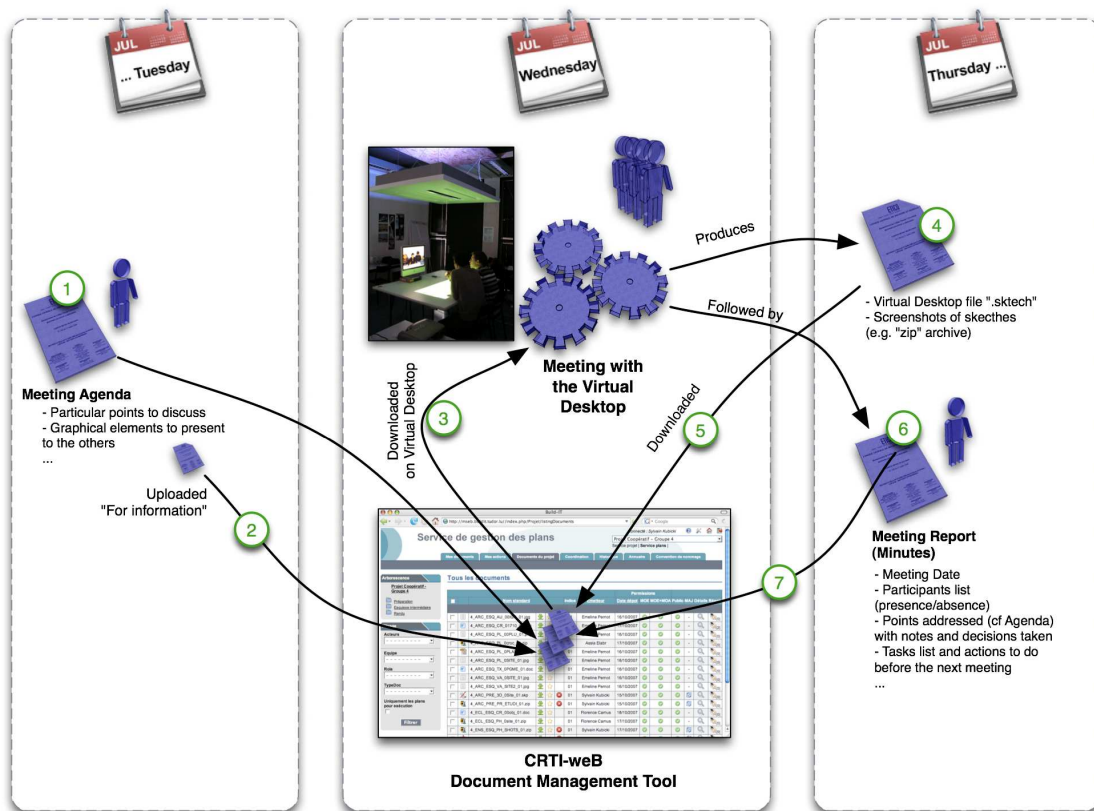

Figure 1: The cooperative process in SDC 07-08

The main idea of this standardized process (see Figure 1) was to sensitize the students to the necessary management of exchanges and interactions that they had to setup in order to facilitate cooperation and to enable coordination of their tasks. At this step they had to decide who could handle the coordinator's role in each group. We will present below in part 4 the tools described in the Figure 1.

The cooperation process could be described in three weekly stages. The central stage was the Wednesday synchronous team meeting. Each part of the teams virtually meets at the same time in Nancy and in Liège. This coordination meeting was the essential stage enabling to share ideas, to debate and to take decisions. Prior to this meeting (each Tuesday) the meeting preparation task

consisted in preparing the documents to be discussed. It was also required to prepare a meeting agenda ensuring to structure and optimize the meeting time. And after the meeting a task of meeting report consisted in writing what had been decided. This essential document was the "written trace" of the exchanges and of the taken decisions. This meeting report had to be approved by all the members of the team.

3.2   Pedagogical inputs and monitoring

The pedagogical inputs consisted both in a set of theoretical courses and in a supervision of the architectural projects' design.

Theoretical courses was taught both in Nancy and Liège through Web conferences. They addressed some topics related to cooperation in design activities and were strongly inspired from theoretical research results. The notions of actor organizations and task coordination are especially focused in these courses. In addition we insisted on examples applied to the design and construction collective activities in AEC. We also taught issues related to object sharing. The standardization of building's object description was introduced through the concepts of digital mock-up and the description of the IFC format.

Weekly supervision in Nancy and Liège consisted in guiding the students in their projects. Architectural and technical options were guided by the teaching team in order to choose forms (morphology) and techniques favouring the involvement of the different roles and the necessity of exchanging information.

Three essential steps had marked out this Digital Studio:

- The kick-off meeting in Nancy allowed all the students to meet, to visit the project's site and to constitute the working teams.

- The intermediate projects' presentation in Web conference was the moment to point out the critical options on the projects and to reinforce the roles of each student in the projects.

- The final presentation in Liège, where all the four projects were presented by the students and evaluated by the teaching team. This presentation consisted of both an architectural/technical/environmental description of the projects and a critical analysis of the cooperative dimension of the studio.

3.3   Feedback from the students

The students' feedback was largely favourable to the pedagogical approach in this Digital Cooperative Studio. At the end of the semester the overall student's belief was that traditional curriculums do not prepare them very well to the cooperative dimension of construction projects. In this way, the theoretical courses associated to the real design project situation were an interesting living lab, where "theories could be applied to real projects". However students noticed also that too theoretical courses were hard to understand/apply. They asked for applied examples to communicate organizational or coordination-related theories.

The unbalanced work-planning between Liège and Nancy students had been also noticed. This has lead to difficulties related to different engagement levels in the projects. This problem intensified another one related to the roles' distributions. In fact the engineers sometimes felt confined to a "verifier" role in charge of validating design choices It was probably due to the unbalanced work-plannings, to a certain lack of teaching instructions, but also to the communication difficulties (due to the geographical distance between students).

Concerning the tools, the feedback had been also globally positive. The use of innovative tools motivate the students. We think that the feeling of participating to the tools' specification/development/improvement is important to stimulate their use. Remarks concerning tools-related feedbacks are developed in parts 4.3 and 4.4.

4 Tools experiment

More than a Master course, SDC is also a real "living lab" to experiment IT-services resulting from research projects. We introduced strong relationships between the work process (Figure 1) and the tools made available to the students in order to facilitate their cooperative distant work.

4.1 Virtual Desktop

The Virtual Desktop is a tool developed by the University of Liège, in Belgium (LuciD Group laboratory[3]). During a distant project meeting, it allows its users to draw and sketch on a shared virtual workspace (Figure 2).
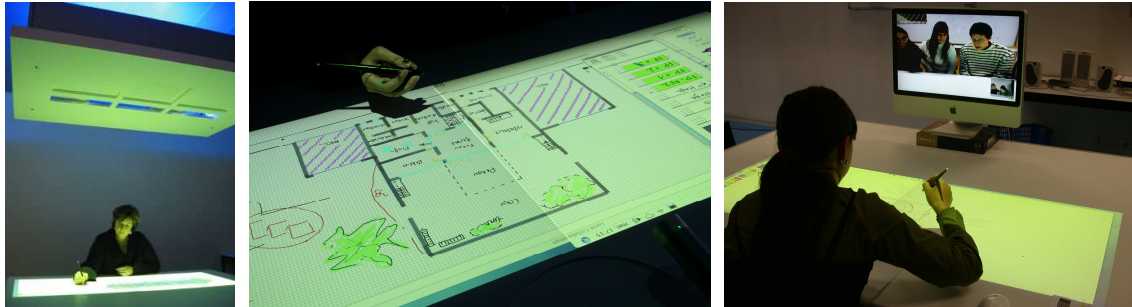

Figure 2: The Virtual Desktop and its software, Sketsha

This tool comprises both a software part and a hardware part. The desk itself is composed of a large tactile table with which the user interacts with the help of a stylus. Two video projectors display a Mac OS X computer environment.

The software "Sketsha" completes this hardware. It allows the users to draw on the table with the stylus, manage sketch layers and the imported reference images. Sketsha displays the sketch on the two distant screens and manage coherence and changes in real time. The users can then co-edit the project while he discusses in real-time with the Web conference system (iChat).

4.2 CRTI-weB: document management tool

The document exchange server "CRTI-weB"[4] is a Web platform developed by the Public Research Centre Henri Tudor in Luxembourg. It consists of a shared project space, available for all the participants of a project from every computer connected to the Internet. It allows the project's members to upload the documents that they produce in order to design the architectural project, and to share them with the others.

The aim is to centralize the documents and to trace their updates and modifications. Moreover it enables also to notify the users when a document is available, and to assign task (requests), such as validation tasks or reaction demands. The reaction functionality is a real "discussion forum" between project members about a specific document.

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[3] http://www.arch.ulg.ac.be/Lucid

[4] A demo access is available at http://demoged.buildit.tudor.lu (login: "demo", password: "demo")
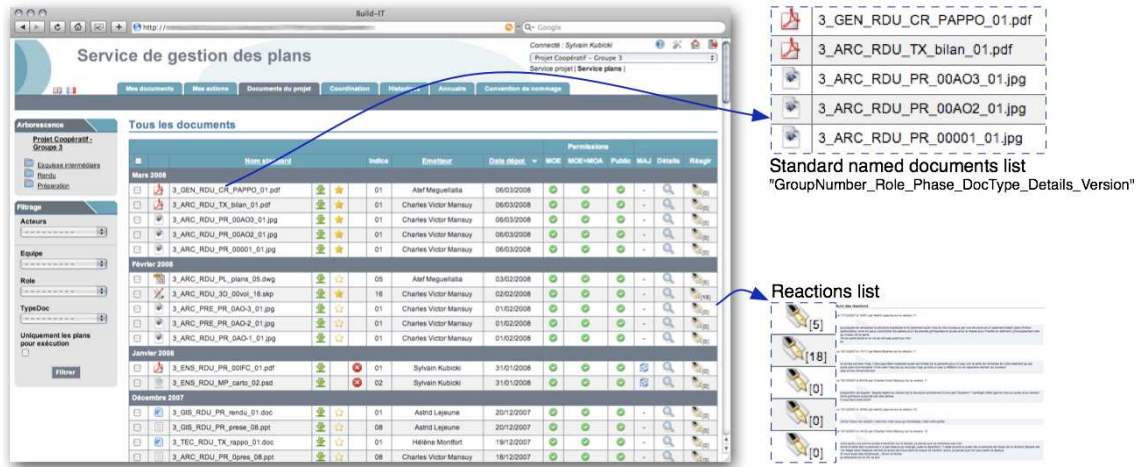
Figure 3: CRTI-weB document management server

4.3   Tools assessment

The use of the research-issued tools led us also to assess on their use in real project's cases. The Virtual Desktop designed as an easy-to-use, sketch-based tool has proved its ability in sketching in a natural way (horizontal table). Moreover its cooperative sketch display was useful in sharing ideas and in co-sketching (2 hands on the same sketch). The students noticed the need to initially understand how it worked, and after that the use was easy and efficient.

The document management server was also assessed during the SDC. The critical point in its use was the definition and implementation of a standard naming for the documents. This point was quite hard to understand for students who were not familiar with the difficulties related to document exchanges between heterogeneous groups of actors. But we can see in the Figure 4 that it was not a problem in the use of the tool. It had constantly been increasing from October to December.

The left graph shows the increasing number of documents uploaded to the server. This number was quite homogeneous between the four groups of students. The right graph shows the number of reactions sent by the students about the documents. In this case we can notice that the use of this functionality is variable between the groups. In fact, some groups had used the tool to communicate and other groups used instead other external communication tools (as MSN messenger).
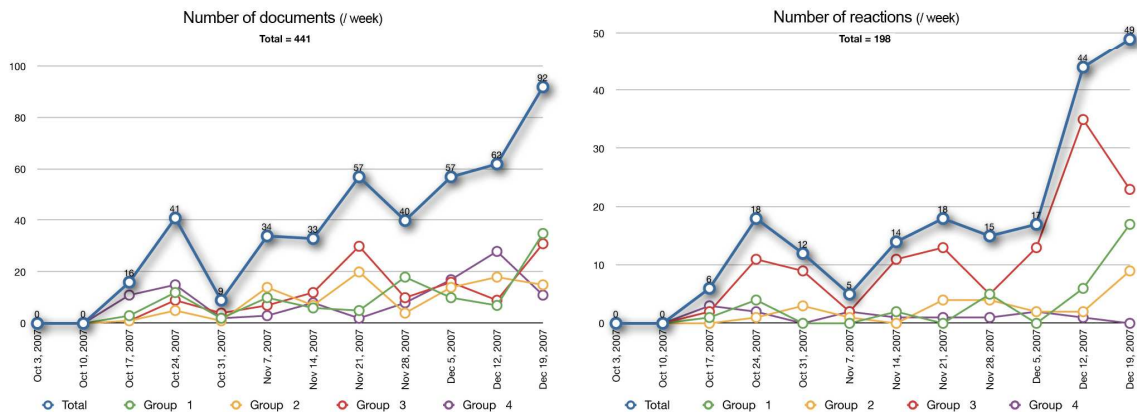

Figure 4: Some figures of the use of the CRTI-weB document management server

4.4   Tools' improvement ideas

During the studio and in the final enquiries we was interested in the feedback about the use of the experimental tools by the students. The difficulties have been mentioned above. But many improvement ideas also emerged. So far as we could, we have tried to take the remarks into account in real time, and to improve and update the tools during the semester. A new release of Sketsha delivered new functionalities to manipulate the sketches (move, rotate…). The CRTI-weB document server was also updated many times, especially to repair the bugs discovered by the students.

In terms of improvement, we noticed the idea of integrating a discussion forum or a chat service in the CRTI-weB server. The notification function was also criticized and should have to be improved through customization options. Some ideas related to visualization of the documents were also formulated, such as preview of pdf documents, or ideas related to the documents' list Human Computer Interface.

Another interesting idea emerged. It consists in integrating the two tools to offer new possibilities such as importing a document directly from the CRTI-weB server to Sketsha, or saving a sketch to the server. This interesting idea will probably be envisaged in future research cooperation.

5   Conclusion

Projects and experiments of collective design are essential in AEC curriculums. Future practitioners have to be sensitizing during their studies to the cooperation mechanisms, methods and tools facilitating their future practice. One challenge for pedagogical teams is to transmit the theoretical concepts related to cooperation and coordination to the students who are often focused on their project design exercises. In SDC we privilege a mixed approach both conceptual and applied. Theoretical courses coming from research developments are immediately applied in the project teams through a standardized basic process (Figure 1) built with the students themselves at the beginning of the experiment. The cooperation was also stimulated by the subject itself: a house of environment. The project had to be designed according to sustainable development criterions and each student carried an organizational role related to a specific criterion.

Beyond the organizational aspects of cooperation we also have to make students aware of the emerging technologies supporting cooperation. A strong link existing between our research projects and the pedagogical studio allows students to experiment innovative IT tools (i.e. groupware). These "living lab" projects are interesting both for the students, future users of cooperation-support tools, and for the researchers, to get feedback from the use of their experimental tools.

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