

Theme:

Title: **A hyperdocument representation of the project for a user-adaptive groupware**

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Abstract: *This paper describes the representation of a project inside a groupware tool dedicated to heterogeneous and short-lived teams. With a few exceptions, the concurrent engineering tools taken from industry and services are not used in building projects. These tools transpose in computer terms existing situations with hierarchical rules. Therefore, these tools couldn't respect the strong autonomy, of the actors in the French building context. The solution, we propose, give a relational vision of the cooperation and of the interactions existing during the processes of conception-construction in architectural works. Our first interest point concerns the representation of the actors, the documents and the assignments as a relational network and not as a hierarchical tree, mostly used in the groupware tools. In a second point, we use this relational network to produce a hyperdocument representation of the project data. This hyperdocument representation gives an adaptive view of the project organization and evolution to each actor in order to display information related to him only.*

Keywords: *adaptive groupware, hyperdocument, project visualisation, cooperation model*

## Introduction

The multiplicity of techniques, the complexity of construction sites and the quality requirements oblige the architectural design projects to be more organized and to use more controlled forms. This kind of project is based on social interactions between actors, and is not based on a hierarchical model but rather on equal relationships directed by a negotiated model [RAY 01].

We think that an aiding tool for cooperative work in the building domain should propose an explicit (directive) coordination of the project based on an implicit (flexible/free) coordination [GOD 01] where the representation of the cooperation depends on the relational organization of project actors. The explicit coordination needs to explicit a process and enforce it. The implicit coordination, which is based on group awareness techniques, supposes an auto-coordination between actors. Thus, an architectural design project owns specific phases, which have to be planned through a process (explicit coordination), and also involves some decision times obtained by negotiations (implicit coordination), which are not often foreseeable.

The low use of the concurrent engineering methods imported from the industry domain to the French building world is not due to a lag of the building domain, but rather to an original context of cooperation. the workflow tools [GRU 94] require a high level definition of procedures and exchanges, which is incompatible with the great flexibility of our current practices.

What we propose is a relational model of cooperation where the information organization reproduces the relational network of the project and can give an adaptive vision of the project evolution to each actor.

The project vision is obtained in a dynamic way by the generation of a hyperdocument, which represents the design team organization, the documents, the activities and all the existing links between every element that the project produces throughout its life.

## The French building context

The French building process is slightly different to the European practices. For example, in the German building process [WEB 99], the 'Call for bid' procedure is part of the Planning phase. In the French



context this procedure constitutes an independent phase. The French building context differs from the industrial world in the following cases :

- The multiplicity and the variety (in size, in means and in method) of the different actors;
- The contractual links between the participants that exist only during a building operation;
- The very Empirical exchange manners of information where oral expression plays an important role;
- The actor system which keeps up dependence relations that are slightly hierarchized;
- The rich competences of actors with fuzzy limits;
- The non-routine character of the processes used in the design and in the project management of works, which are often prototypes.

The main characteristics of a building project that influence the context of collaboration are :

- an increase of the quality requirements,
- a reduction of the conception and realization delays,
- a high level of document exchange,
- a re-composition of the design team in every new project.

In this case, no actor has the means to impose his project vision to the others. This induces the building sector to look for new modes of cooperation as they already exist in industry and services.

### Existing models and tools

With a few exceptions, the concurrent engineering tools taken from industry and services are not used in building projects. We go on the assumption that the lack of use of these tools is due to a non-fitting to the specificity of the building sector. The common tools can be classified in four types [GRU 94]:

- Tools based on electronic mail,
- Groupware tools,
- Workflow management systems,
- Electronic drawing management systems,

These tools try to transpose existing situations in computer terms and frequently use some hierarchical rules to organize information. Then, a data hierarchical model is used by most of the current groupware tools, specific or not for the building trade (BSCW, Teamwave, Buzzsaw, Batibox,<sup>1</sup> ...). In order to show the lacks of this kind of systems, we've studied a groupware tool used during the conception of an urban planning project [HAN 01]. The organization of project information is expressed through a system of files and folders. To preserve a meaning outside the system, the name of a document should reflect its position in the system. Thus, the use of these tools are based on rules of naming files and graphic charters. It is difficult for these rules to keep still during the realization of the project. The more the number of users and documents increases, the more it is difficult to apply the existing system of naming, storing and browsing because the hierarchical structure management coerces the actors into generating many file copies. Therefore, these tools couldn't respect the strong autonomy, which characterized the actors who collaborate during a building project.

The available models used in most existing tools do not allow to represent the relational network that exists and evolves between actors during the project lifetime. These models, based on a hierarchical representation of information, force the project organization to have either a document oriented structure, or an activity oriented structure, or an actor oriented structure, but never the three structures together.

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<sup>1</sup> BSCW : <http://bscw.gmd.de> ; Teamwave : <http://www.teamwave.com> ; Buzzaw : <http://www.buzzsaw.com> ; Batibox <http://www.batibox.com>

## Relational model of cooperation

As showed before, the building trade represents a particular context of cooperation. This cooperation results in hierarchical and cooperative interactions between actors. The exchanges between actors do respect a hierarchy, but imply all the actors in the design of the final object. This situation is characterized by a "mutual prescription" [HAT 96] between designers. Thus, each component of the project owns an environment with specific relationships. For example, an actor keeps up relations with its related documents, the activities he takes part and the others actors who participate to the same activities. The 'relational model ' will be the representation and the characterization of these interactions in an architectural project.

### Main concepts:

Two approaches has been identified in cooperation modelling field [CIS 96] [TUR 97]: activity based and communication based models. Our proposition is situated at the intersection of these two approaches, it gathers at once processes (activities) and exchanges (communication) modelling.

The definition of the model concepts carries on with those included in the works about groupware conceptualisation [ELL 94], [SAL 95] and [CIS 96]. These definitions will help us to understand how to use these common concepts in a new representation of the collaboration in a project.

### Actors:

In a project, each actor owns a limited capacity of action and a restricted decision-making autonomy. An actor is characterized by his company, his hierarchical level, but also by its own range of competences. For example, an architect cannot be only defined by his profession because he may have one or more specialities in a particular construction technique (wood, metal, or concrete) or have an experiment in some software tools. These data related to actors' competences allows to clarify and orient the role attribution inside the project and the possibilities of action resulting from it.

The actor acts inside the activities constituting the project, gives his opinion, keeps up relations with his environment while collaborating with other actors and producing documents.

### Documents:

A document represents a professional "deliverable" piece, the sets of parts relative to a particular point of a contract. For example, the invitation to tender document will include plans, spreadsheets and texts. A document is an aggregation of files manipulated with an operating system. A document can group several other documents. Lastly, documents are generated by actors during activities.

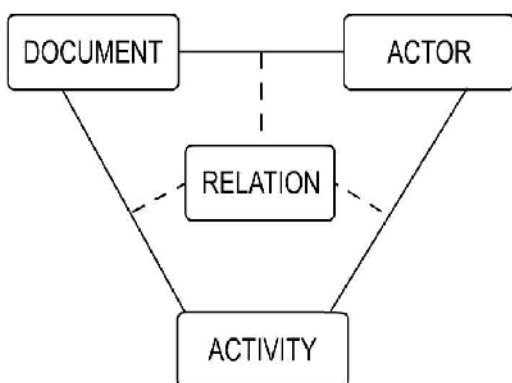


Figure 1: Relational triangle

### Activities:

The activities inside a project have several levels of granularity: project, stage, milestone, and task. The French law about building project management defines legal stages of a project and the corresponding levels of drawing scale. The milestones separate two validation meetings inside a phase and the tasks constitute the smallest element of an activity [AFI 91]. We can isolate four activity categories:

- Explicit coordination activities: actors management and tasks management,
- Implicit coordination activities: request management,
- Production activities: document creation and revision,
- Synthesis activities: document validation or merging.

Implicit coordination is mainly done by sending requests between actors. They can be associated with documents and make it possible to give specific signification to exchanges [MAL 00]. The requests that we consider in our model are as follows:

- For information,
- For consultation,
- For advise,
- For modification,
- For validation.

Requests can also be generated by a reminder software to inform the actors.

We can notice that these fundamental concepts maintain reciprocal links we have generalized under the concept of “relation”. It enables us to define the “relational triangle” (Figure 1).

### *Relations*

A relation identifies a type of link existing between two elements of the model: Actor, Activity and Document. These relations can be grouped into categories:

- The relations between actors and activities are closely dependent on the role of an actor in an activity (responsible, producing).
- The relations between actors and documents are close to those used in the edition: Supervise, Produce, Comments, Consults, Revise, Diffuse.
- The relations between activities and documents are relative to the production of information: Generate, Uses (technical requirements, Rules, Contracts).
- The relations between actors find their terminology in the human resources management: Manage, Contribute (provides and receives information).
- The relations between documents are those used in the configurations management: new version, refers to, is the synthesis of etc....
- The relations between activities are relative to planning: follows, precedes, is included in etc.....

The relation that links actor and activity constitutes a particular case, because it is a condition for the other relations determination. This relation represents the role of an actor in an activity.

### *Actor-activity relation, the actor's role*

Each actor has a specific role in the project; this role is defined according to the contracts signed between actors. Responsibilities can be assumed by turns by several actors during the life of the project (according to their reciprocal expertises). For example during the draft design, the responsibility will be given to a 'creative designer', whereas for the building site it will be given to a more pragmatic actor like an engineer. The roles translate the implication of an actor in a project [HAN 01], it depends on the actor's status in the group (its responsibilities) and on his competences. The roles which an actor can hold are:

- Responsible (validate)
- Coordinator (attributes tasks)
- Producer (create information)
- Consultant (answer to a specific need)
- Reader (spectator)

The role makes possible the definition of the place occupied by each actor in an activity. It indicates his importance, and it induces the types of relations an actor can keep up with other participants and documents. The role of an actor in the project will be a combination of these unit role. A “consultant” in an activity can become “coordinator” of another activity of the project.

### *Actions*

The actions are deduced from the relations and describe the interventions an actor can carry out on the other actors, the activities and the documents. The relations make possible to define what we name the

"action rights " rather than the "access rights" which are so difficult to configure in the existing groupwares. These actions are connected to the operations defined on the principal components of the model (figure 2). For example, the role of the coordinator gives the following action rights:

- To plan a meeting (activity)
- To assign tasks to other actors (actor)
- To define objectives and deadlines (activity)
- To add or remove actors (activity)
- To define the documents to be produced (document).

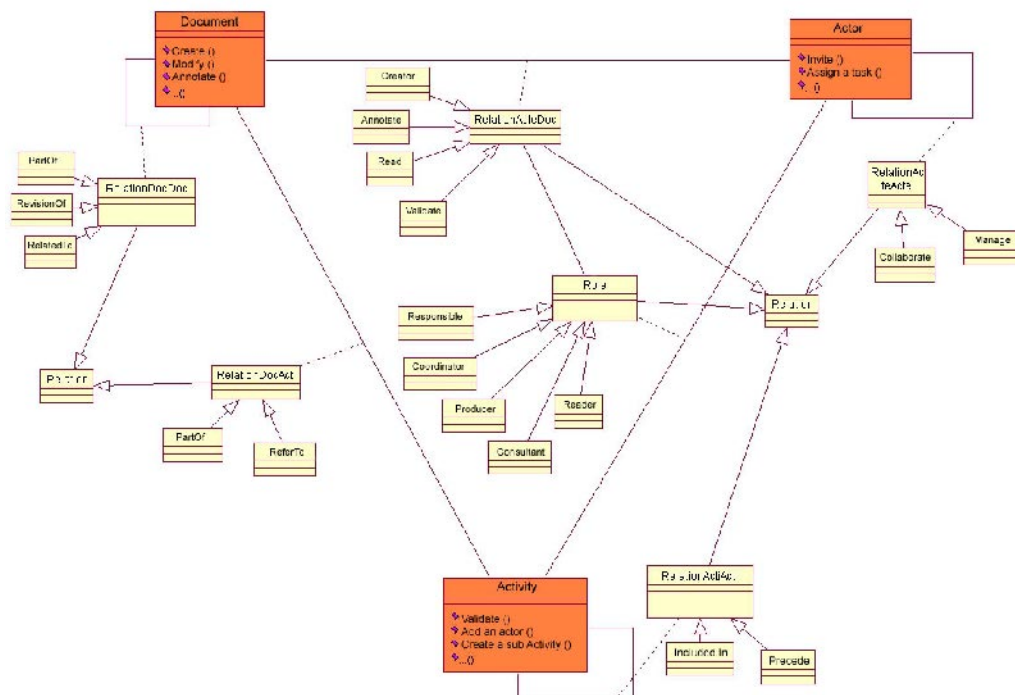


Figure 2: The relational model of cooperation (designed with UML)

### Project vision : an adaptive hyperdocument

The search on information visualization [HER 00] and on adaptive hypermedia [BRU 96] enables us to identify new ways of user information presentation, more suitable to our cooperation model. These modes of user's presentation make possible to show the links existing between actors, documents and activities in the form of a graph of nodes (actors , documents and activities) and links representing the roles and relations.

#### Adaptive hyperdocument

The information we have to display are a translation of real and virtual items like actors or tasks and their relations. To perform this representation, we choose to use a context-adaptive hyperdocument. A hyperdocument [CON 87] is basically a collection of information items called nodes and connections between them, called links. In our context, the links express the relations existing between the project elements and could be general, as a HTML link, or more specialized in order to fit to the complexity of the relations existing in a project. In our model, the nodes are actors, activities and documents. We introduce some different types of link, which express the relations we have shown in the previous part.

#### Navigation

To be user adaptive, the hyperdocument have to be different according to the user role inside the project. The role played by each user allows to active the information (nodes and links) to display to the user. For example, an administrator may not have the same vision of the project than a simple reader. For the navigation, we choose to present, with three views, the three main concepts we isolate as points of view on the project evolution: actor view, document view and activity view. The user can switch between these views by clicking on a specific item and making a focus on it (actor, document, or activity) or by choosing the corresponding view.

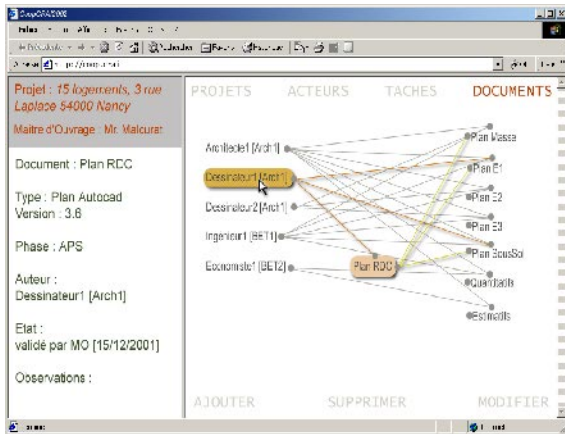


Figure 3: document view

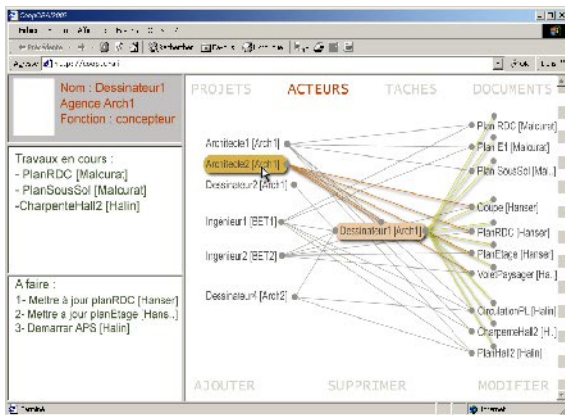


Figure 4: actor view

*Visualisation :*

To show the structure of this hyperdocument, we have to draw a graph of links and nodes. The result is a fish-eye view [FUR 86] of the relations in a project. Two problems are rising out: how to determine the zooming ratio and which distortion is acceptable. The zoom on the network structure depends on the quantity of information we can give to the user, and the distortion is the different types of information we can show at the same time. For example, when a user requests for the ground plan of a house project, it will be effective to show the related items like authors, first floor plan or elevations. But displaying all the revisions of each document must not be pertinent. Thus, we decide to center the view on the selected item and let the user to choose the zoom ratio with a graduated scroll bar.

*Implementation :*

According to this logic, some tools start to appear (Thinkmap, TheBrain, Touchgraph<sup>2</sup>). We are currently looking for adapted one of these by defining specific types of links and by organizing the various categories of nodes in the interface. The following image represents what could be the vision of the project through a tool adapted to our field (figure 3 and 4). Graphic elements such as the colour, the form and the size allow several levels of reading and interpretation of information. This graphic semantic aims to helps the user to find pertinent information about the project evolution.

**Conclusion**

The relational model of cooperation proposes a new organization of information closer to the real building context and gives a new dimension to the groupware tools. The relations we identify allow an adaptive navigation inside the project represented by a hyperdocument. The adaptive character of such a navigation is obtained from roles and relations of each actor. Roles and relations are determined from the actors' specificities, which evolve along the project life cycle. Thus, the user's presentation of the project progresses at the same time than the real interactions between actors involved in the project. Our work is still under development and the concepts stated in this article are currently implemented in an experimental tool. A realistic validation of our proposal can only be done by one experiment on a real

<sup>2</sup> www.thinkmap.com, www.thebrain.com, www.touchgraph.com

project. This project will implicate some architects, engineers and project owners in a building process. Results of this experiment will be available in a few months because of the project schedule. Our goal is to propose an adaptation of the existing functionalities to produce an information presentation more suitable to the specificities of our sector. The experiment will show the benefits of this new project vision.

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