Toward a user adaptive vision of architectural projects

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The architectural conception is a particular cooperation situation. One characteristic of this cooperation is a “mutual prescription” between actors through a specific relational organization. Then each actor keeps up specific relations with others people (designers, project managers,…) but also with documents and activities. The representation of such network, which characterizes each project, is the one of the objectives of the “Relational model”. The existing groupware tools can not be directly used in the framework of the architectural conception. They require a high level of definition of procedures and exchanges, which is incompatible with the flexibility of current practices. The second objective of this model is to give to each actor an adapted vision of the project evolution. This representation has to be adapted to the role and the participation of the actor at each moment of the project life cycle. We propose in this article an open hyperdocument structure based on a relational model of cooperation. Some experimental views and navigations are exposed and commented. The integration of this new dimension allows to propose to the user an adapted vision of the project by taking into account the role he plays inside the project.

Keywords: Cooperation model, groupware, cooperative work, project management, architectural project

Introduction

A conception project is a professional and social activity inside a group of actors which belongs to a same or different organizations. The actors cooperate to achieve a same objective which can be the production of a document, a manufacturer product, a plane or a building. The role of a cooperative project management tool is to offer to each actor not only a good vision of the project evolution but also the extent of his potential of actions.

During the last decade numerous experimentations of groupware applications have been done in every industrial domain and obviously in the building trade, e. g. ToCEE project, Esprit program (Turk & al.). These tools seems to be more suitable to hierarchical organizations and well defined processes. Indeed, most of experimentation held during the construction time or during semi-industrial construction processes with a pre-defined architectural elements catalog (Weber and Partsch). In these situations, the process is well known and enough repetitive to use a workflow application (Casati & al.).
In an architectural project, the interactive situations can be decomposed in two families associated with two phases of a project: the first one during the conception phase and the second one during the construction phase. During the conception phase the cooperation is less formal with many revisions and alternative solutions. The construction phase is characterized by a more hierarchical organization of the actors and of the documents. We make the assumption that the main challenge for developing coordination tools dedicated to the architectural conception process, is to display correctly the pertinent information of the project evolution (Malcurat & al.).

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**Construction and conception processes**

The differences between conception and construction processes can be put in light with a multi-dimensional graph (figure 1) obtained with the knowledge on the construction process (Armand and Raffestin).

**Organization:** this axe describes the social organization of the group. In a hierarchic group, one actor manage all the workgroup. In a cooperative group, the actors work together in a consensual way.

**Document stability:** along the conception phase many document versions and research drafts are produced which are continuously reconsidered. During the construction phase, the documents are more rationalized and technical; they are generated with a more linear manner.

**Meeting style:** a conception phase need to expose many conceptual choices or ideas during “brainstorming” sessions. The construction process is based on validation steps and task assignment meetings.

**Coordination:** explicit coordination consist in a pre-definition of interactions between actors, e.g. planned tasks, periodic meetings, deadlines. Implicit coordination is a non planned actor interaction (Godart & al.) discussion, information exchanges...

**Process precision:** in a construction process each task is planned, its start date, its duration, its end date are known. In a conception process, we can isolate some documents to produce but, we don’t know precisely the activity succession which is needed to produce these documents.

**Conceptual model of cooperation**

The building trade context represents a particular context of cooperation (Bernoux). This cooperation results in hierarchical and cooperative interactions between actors. 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 have been identified in cooperation conception field: activity based and communication based models (Hanser & al.; Turk). Our proposition is situated at the intersection of these two approaches, it gathers at once processes (activities) and exchanges (communication) modeling. The definition of the model concepts carries on with those included in the works about groupware conceptualization (Cisse & al.; Ellis & al.; Salvador & al.). These definitions will help us to understand how to use these common concepts in a new representation of the collaboration in a project (Halin & al.).

Our model is based on the relations existing between the elements of a cooperation project: Actor, Activity and Document to form the relational triangle of cooperation (Figure 2). The relations can be grouped into categories e. g. Actor-Document, Document-Activity or Actor-Activity...

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**

The role is a particular relation between actor and activity, it defines the type of participation that an actor have in an activity (Ginsburg & al.). The role played by an actor in a project is difficult to define precisely because it is composed by the professional capacities and the place he has in a project (figure 3).

At the organization level, we can identify an organizational role which describe the position of an actor in his enterprise. This role expresses the hierarchical level and the competencies of an actor.

At the project level, we can isolate a procedural role. This role translates the missions...
attached to an actor, these missions depend on the contracts and on the project type. For example, an architect can be consultant in a project and responsible in another.

In a project phase, each actor owns an operational role. This role is linked to the project management and conditions the interactions between actors. For example, an architect could be responsible of the architectural definition and an engineer responsible of the final drawings. From this last role, we can identify a pattern of action rights (Cisse & al.) according to the knowledge we have about the conception process (French laws and practices). These action rights describe the capacity of an actor to perform some operations in an activity.

The information we have to display are a translation of real and virtual items like actors or tasks and their relations. In our context, the links express the relations existing between the project elements and could be general, or more specialized in order to fit to the complexity of the relations existing in a project

The search on information visualization (Herman & al.) and on adaptive hypermedia (Brusilowsky) enables us to identify new forms of information representation, more suitable to such project organization. The project organization and evolution can be viewed as an hyperdocument where each node is a piece of the project information (document, activity, actor) and the links are the relations that exist between each project piece (produce, manage, use...). The information access is then a navigation inside the hyperdocument. This navigation can be adaptive according to the user’s role inside the project.

Hypermedia and project management
The hypermedia technology proposes an alternative way of information organization. The flexible dimension of the hypermedia has also seduced the CSCW domain, which uses it in a collaborative way for Hypermedia authoring (Streitz & al.) or the adaptation of the properties of a shared space and for the definition of processes within a working group, as in the CHIPS project (Co-operative Hypermedia Integrated with Process Support) (Wang & al.). The WWW and its distributed hypermedia structure has extended the space of collaboration either in collaborative information management (Ginsburg & al.) or in collaborative project management (Indrusiak & al.). The geographical distribution of the actors, implicated in the distributed systems of collaborative project management, has contributed to favor the development of synchronous communication tools in order to improve the group awareness (Greenberg & al.; Dourish & al.) instead of the project information management.

Our contribution is situated at the representation level of a project inside a distributed work group. In this representation, the role of each actor is taken into account and the group structure does not rest on a hierarchical organization. We make the assumption that more the project representation reflects the relational and social organization of the real project, more the vision of the project proposed by the system can be suitable and adapted to the users.

Hyperdocument model
The available models used in most existing collaborative project management 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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The hypermedia techniques allow to manage and to navigate in such structure which is called hyperdocument. A hyperdocument (Halasz & al.) is basically a collection of information items called nodes and connections between them, called links. The open hyperdocument is obtained by transforming the relational cooperative model into a hyperdocument model.

**Project navigation**

**Visualization**

The visualization of this hyperdocument can be obtained by a graph visualization technique which represents the network organization of the project (Herman & al.). In this kind of visualization, the quantity of information and the number of different type of information is important to determine. People are not accustomed to handling this type of interface, the network complexity has to be discovered gradually by the user. In order to reduce the apparent complexity of the graph, the drawing can use specific representations of the model concepts in terms of form, color and size. Actor, Activity and Document have to be represented with different forms, the color can be used to indicated the state of an object (Activity: not started, in progress, terminated). The form can also be used to allow the user to identify the type of a document (norm, plan, administrative document), an activity (phase, task, procedure) or the profession of an actor (Architect, engineer, Agent of administration,...). The form, the color, and the length of a link must give an indication of the type of relation it represents (role of an actor, reference between documents, task sequence).

**Navigation**

The navigation tools must proposed a set of functions to allow the user to manage the graph. An incremental navigation is wished, it can be structured in clusters (Herman & al.) following the activity/sub-activity structure or document folder/document structure or actor group/actor structure (the navigation is then close to those present in a hierarchy) or by node expansion (the linked elements are drawn where the node is selected). Some filters can be useful to select inside the graph the pertinent information to be view. The filters must allow the user to choice among the types of node and links the information he wants to see. For example, an actor who wants to know the actors with which he will work and in which activities, has to select actor nodes and activity nodes and rejects the document nodes.

**User-adaptive Navigation**

Each actor of the project is a potential user of the cooperative platform. In the relational model of cooperation of the project, each actor owns a profile which describes its competencies and its trade activities. In addition, all the roles that the actor plays in the activities of the project are known. By taking into account this set of information, profile and role, attached to each actor/user, we can propose an adaptive navigation to each user. The actor’s profile gives information on the user: the type of documents he can visualize, the type of project view he can apprehend and understand (Gantt view, 2D or 3D view, version graph of documents...), the type of computer equipment he has etc... The role played by each actor in project activities allows the system to define the nodes and links to display and the precision level to take on each node. For example, a supervisor of an activity may not have the same vision the activity node representation than a simple reader (Figure 4). The supervisor can navigate inside the sub-activities and can access to the different versions of the activity documents. Whereas, a reader has
only the possibility to see the activity node and the related document nodes. He can see the state of documents indicated by the color of the node; he can access and visualize document only when it is finished. A user-adaptive view may allow a user to evaluate all the tasks he has to realize inside a project or for all the projects managed by the cooperation platform.

**Experimentation and future implementation**

The relational model of cooperation has been partially validate with an urban project done by students, professors, local town council and a neighbors committee. All the interactions have been analyzed in a high detail level and implemented in a database to test the compatibility of our model with the reality. An other experience is now engaged; it concerns a real architectural cooperation project. The future cooperative platform which is currently developed has been chosen to manage the project information. The evaluation of this new experimentation will allow us to measure the pertinence of the model and of its hypermedia representation.

To be used by all potential actors of a cooperative project as those existing in a building conception project, we chose a web client/server architecture. This architecture respect the MVC Smalltalk paradigm (Gamma & al.) where the view role is hold by the TGLinkBrowser java applet, the hyperdocument object plays the control role and...
the model role is represented by objects which instanciate the relational cooperation model presented in this article. The object persistence will be managed by a relational DBMS system. (figure 5).

**Conclusion**

A cooperation model is characterized by interactions inside a network of actor. The relational model of cooperation proposes to represent such actor network which is present in the conception building process. 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 goal is to propose an adaptation of the existing functionalities to produce an information presentation more suitable to the specificities of our sector. The relational model of cooperation proposes a new organization of information closer to a real cooperation context and gives a new dimension to the groupware tools. The proposed relational network visualization of a cooperation project allows the user to evaluate the project evolution or to determine easily the extent of its participation. The new version of the cooperative platform will be evaluate with a real project in the building context in order to validate our proposition.

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