# An Advanced Groupware Approach for an Integrated Planning Process in Building Construction

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## 1 Abstract

Increasing complexity of today's buildings requires a high level of integration in the planning process. Common planning strategies, where individual project partners cooperate mainly to exchange results, are not suitable to jointly develop project goals and objectives. Integrated planning, a more holistic approach to deal with complex problems, is based on a high degree of communication among team members and leads to a goal oriented cooperation. This paper focuses on the application of an advanced groupware approach suitable to support efficiently an integrated design process in construction. First an appropriate planning process model will be presented, which differs from common product model approaches and takes into account the great importance of team- and goal orientation in integrated planning. Then the idea of an open CSCW-platform is proposed, which basic structure and containing elements are based on the defined planning model. Appropriate cooperative planning scenarios can then be ad-hoc modeled and configured dynamically on this CSCW platform according to the requirements of the specific project. For the participants of the planning process, the resulting groupware approach represents an integrated computer based working environment. This environment allows a kind of immersion into the project. Finally a prototypical implementation of this approach will be shortly discussed.

## 2 Motivation

In almost every area of planning the demand dealing and solving problems following a more holistic approach is growing, which means to take into account aspects outside the own point of view. This is especially true in the area of architectural planning, where the common planning strategies result into many problems. Some of the reasons are: Most buildings are one of a kind products, big and heterogeneous consortia, individual customers and the dynamic in goal definition and requirements. It can be expected, that many of the resulting problems are avoided by following an integrated planning approach.
To combine a growing specialization of the individual and a holistic view, the application of cooperative and team oriented method of working seems to be suitable.

So the individual competence can be used as best as possible and at the same time it can be integrated efficiently into the overall context.
Therefore our efforts towards an integrated planning process focus on establishing an higher level of cooperation and goal orientation. The application of team-oriented working methods requires changes in management and information-technology. The research area of CSCW addresses the basic theoretical principles of computer support of cooperative work. The expression *Groupware* is used to denote systems, which implement some of the concepts of CSCW. Those systems contain implicitly aspects of cooperative working methods. Therefore the application of groupware systems without appropriate planning methods gives away a big chance for improvements and could sometimes also lead to the opposite due to frustration by not coming up to the high expectations. I will cover both aspects in this paper - the planning model and the groupware approach.

## 3 Integrated Planning Model

### 3.1 BACKGROUND

As mentioned above we need a planning model, that focuses on cooperative and integrated methods. Figure 1 shows the focus of traditional and future planning models. Whereas today the focus is still on passive methods like being informed, the new planning model emphasizes the active role of the planning participants as cooperating team-members.

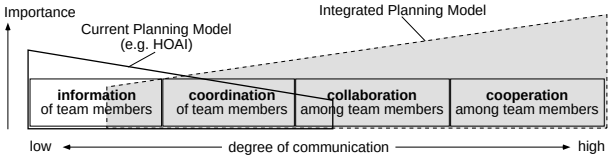

Figure 1. Focus of different planning models

There have been several approaches to model design processes by formalizing logical and physical dependencies on the level of design objects and linking communication related aspects to them. This leads to complex deterministic product models, which are hard-coded in solution strategies. They are only valid for projects with very specific and restricted requirements. Common product models can be used as database models for particular CAD tools. However, this approach seems not to be suitable to support an integrated design process with dynamically changing requirements.
Unlike the concept of a product model, which is focusing interactions on a generic geometrical model of the planning object, the presented idea is approaching the problem by viewing and modeling goals and requirements. From this point of view a project structure matching the planning task

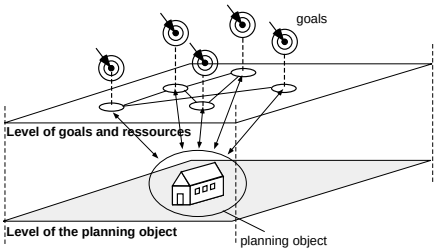

Figure 2. Two level approach of the planning model

is derived, which can be adapted dynamically by detailing the goal and task definitions. The two different approaches can be figured out by defining two levels looking onto the planning process (Figure 2).

### *3.1.1 Level of project goals and resources*

At this level it is possible to structure a project in any meaningful kind through providing planning scenarios. After that it transforms itself to a platform allowing a continuous and dynamic structuring and organization of the cooperation process. This concerns e.g. the definition of goals, tasks, information infrastructure, tools, methods, roles, and the allocation of resources in every respect.
This level offers every participant of the planning process the context for his individual contribution, and is therefore a system for the metaplanning („planning the planning“). This makes it possible to integrate knowledge and experience over all stages and in all tasks of the project.

### *3.1.2 Level of design objects*

Generic problem areas such as architectural design require a high degree of freedom of choice and the ability to compromise on certain subjects in collaboration with others. Because of this, the variety of solution strategies to implement design objects can not be predetermined and is therefore only limited by the ability of team members to innovate new solution strategies. Various partial models of the planning object can be found on this level, which are different in abstraction, aspects and representation. They will be integrated according to the commitments on the other level.

## 3.2 THE PLANNING MODEL

The planning process model is based on the idea, that the complete planning task can be described as a net of interdependent task bundles (Figure 3.). These task bundles will be handled collectively in a team-oriented manner and will be indicated in the following as *nodes*. A node is determined by the goal or task definition in his center. The definition of the tasks is derived in a iterative and holistic process based on the goal definitions by the team members of a node. This is a fundamental difference to common planning procedures.

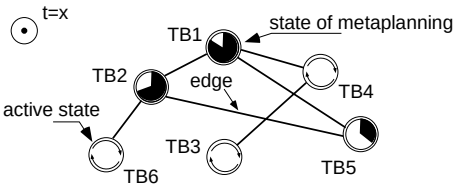


Figure 3. Project represented as a net of interdependent nodes

The particular task bundles can have logical and informational dependencies on each other. These dependencies are called *edges*. This means that for integrated handling of each task bundle, information and resources from others are necessary. At the beginning of a project, edges are qualitative descriptions at any level of detail of dependencies between collective tasks. Based on the so described dependencies, information flows are growing in different ways along these edges during the project. Every edge has an administrator. He must be a node team member connected by the edges. He

guaranties implicitly initialization, control, and coordination of information flows between nodes (Figure 4). This role must be filled permanently during the project. The process to obtain a meaningful system of nodes and edges will not be discussed here due to the conciseness of the paper.

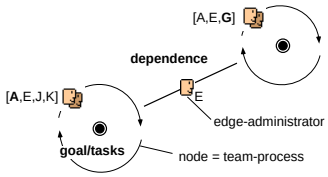


Figure 4.

Beside the trivial final state, every node can have two states, which are taken on in this order at least one time: *State of metaplanning* and the *active state*. The function of node state of „metaplanning" is planning the planning process with the goal to achieve the ability of work of this node as soon as possible. This is defined as the complete definition of all aspects linked to the node for the specific planning task. These are:

- Definition of the tasks based on the goal definition
- Setting up the team: roles, competence
- Selection of the methods , tools and partial models to be used
- Setting up and configuring the information infrastructure
- Allocation of resources

After completion of the metaplanning state the node switches into the active state, where the task oriented cooperation with the goal of achieving the task linked to that node begins. If there is any change in goal or requirements, the node switch back to the metaplanning state trying to reach as soon as possible the active state again. This is going on until the goal is completely achieved (final state).

Unlike the common way of structuring the architectural design process, e.g. the German HOAI, project related phases are not taken into account for the concept of the planning process model. The structure of the planning process model is identical for all project phases and sees the project as a system of nodes, which must be dynamically configured and worked out (continuous switching between the two node states). Because of that and the importance of early project phases, all task bundles start jointly at the beginning. Figure 5 shows that all nodes start at the same time with their node state of metaplanning, but switch differently into the active state. It is not necessary to define constraints of time because it can be seen as a resource or results implicitly from the logical and informational dependencies. In summary, the planning model can be characterized as follows:

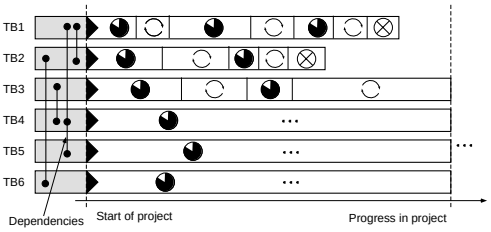


Figure 5.

- Linked multi-team concept; best benefit of the human resources
- Project structure and -management follows dynamically the requirements of the planning object
- Planning model is restrictive on the level of goals and tasks
- Dependencies between task bundles are especially taken into account

## 4 Advanced Groupware Approach

### 4.1 CHARACTERISTICS

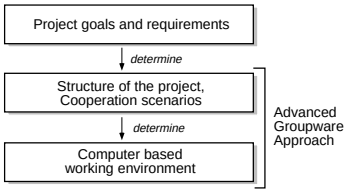


Figure 6.

Carrying out a project following the presented planning model results in high requirements regarding dynamic and flexibility, so that it can be achieved only with an appropriate computer support. The idea is to merge project structure and working environment (Figure 6). This enables a kind of immersion into the project through the working environment, which always represents the current project state. Common concepts and methods in the area of CSCW research or characteristics of existing groupware systems will not be discussed here. The following will summarize the additional aspects of an „advanced“ groupware approach, to fulfill the requirements of presented planning model.

#### *4.1.1 Interactive modeling of the planning environment*

An important aspect of the planning model is the phase of „metaplanning“. That means, that a continuous planning of planning and specification of the working environment is also a project planning task. It must therefore be possible to model the net of nodes and edges as well as the cooperation scenarios within a team-process (node) while the project is running. This includes definition of tools, team members, their roles, information-management , etc.

#### *4.1.2 Integration by the context „node“*

To be aware of the context is a very important aspect to achieve an effective cooperation. In our case, a node represents a context, where all the resources are collected, that are necessary to achieve the goal linked to him. Therefore a node is the main structuring element. Everything involved is part of the resources: task definitions, team members, tools, etc. as well as the complete information, created in or flowing into the node. An imported conclusion is that the information management always follows the project structure. For example, tools needed for the tasks in the specific context e.g. can be collected in a toolbox linked to the node and offered to the team.

#### *4.1.3 Extended awareness*

Modeling, the integration by context and navigation in a project makes great demands on the graphical user interface to represent and visualize the project and the working environment. It seems to be suitable for that handling metainformation, which can be used for the representation of the objects on the GUI.

## 4.2 PROTOTYPE „P3“

*P3* is a Client/Server based software study, based on the idea of providing meta-information and references (URLs) of a project. This meta-information can then be used to configure the particular working environments of the users. The project models are managed by a RDBMS. The *P3* client allows users to access the database server and to model virtual project scenarios. *P3* points to the basic structure of the System: projects consist of (team-)processes involving a number of persons. Figure 7 shows the client project window, with a list of processes and persons. Double clicking a process topic in the list opens a process window with icons representing the team incorporated members. Attached to every process is a specific toolbox, an information container containing URLs (ftp-protocol) and a window with roles, that can be given to the team members. The third window at the bottom shows information about the particular working environment of the user like his communication possibilities, existing tools, his photograph and URLs to WWW-based information. The project scenario can now be modeled easily by drag&drop operation of the elements.

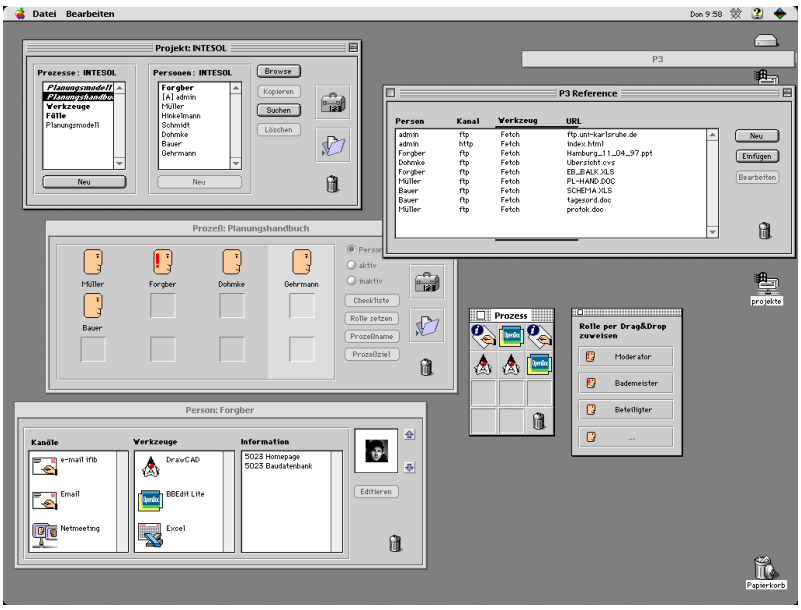


Figure 7. Screenshot of the prototype P3

# 5 Conclusion

The idea of a new integrated planning model and an appropriate groupware approach was shortly discussed in this paper. The presented aspects are part of various research projects and my doctoral thesis currently undertaken in at the „Institut für Industrielle Bauproduktion“, Prof. N. Kohler at the University of Karlsruhe, Germany.