Theme:

Title: **A knowledge-based co-operation model for process-oriented management of AEC-projects**

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Abstract: *The aim of this contribution is to present the concept of a goal- and process-oriented cooperation model for AEC projects, which permits a acquisition of the high dynamics of planning processes. The Model is based on the planning philosophy of integrated planning (IP), which pursues a life cycle oriented and holistic planning approach. Thereafter the different partial models – system of tasks and objectives, organization model and process model - are introduced. In addition there will be shown a corresponding implementation of the model in an Internet -based cooperation environment.*

Keywords: *Computer Integrated Planning*

Computer Supported Cooperative Work (CSCW)

Process and Task Management

Lifecycle oriented Co-operation Model

Knowledge Management

Introduction

The increasing use of modern information and communication technologies in the commercial field leads to a considerable change of existing forms of work, structures of enterprises and internal processes which lead to virtual enterprises. Multi-disciplinary problems of high complexity and innovative development projects in the field of Architecture, Engineering and Construction (AEC) seem to lead especially to promising solutions, but also need new requirements in the form of co-operation.

According to [1] there are in existing theories of organization, no satisfactory answers to specific problems of co-ordination in spatially distributed but still collaborative work. A model of co-operation is presented that enables spatially separated co-operation in a holistic and team-oriented manner for dynamic multi-disciplinary development projects.

Knowledge Management in Cooperations

The specifications, subjects, constancies and legal foundations of cooperations have changed strongly within the second half of the 20th century and these changes are likely to intensify in the future. Companies have got aware of this progression and so they have started to restructure various, in-house departments and configurations. These developments are visible e.g. in the selection of personnel, where demands on employees concerning qualifications, flexibility and the readiness for advanced vocational training have risen steadily. Modern firms also have invested intensively in the working environment of their employees, such as modern, networked computer terminals. Furthermore new models of employment contracts have become common, the number of temporary employments has increased enormously and the stipulations about the field of functions and the place of employment have become far more flexible. Above all, new forms of organisation and recent corporate structures, such as virtual enterprises, rearranged hierarchies and outsourcing, have changed the general economic framework and therefore the operating requirements of the industry in total [10].

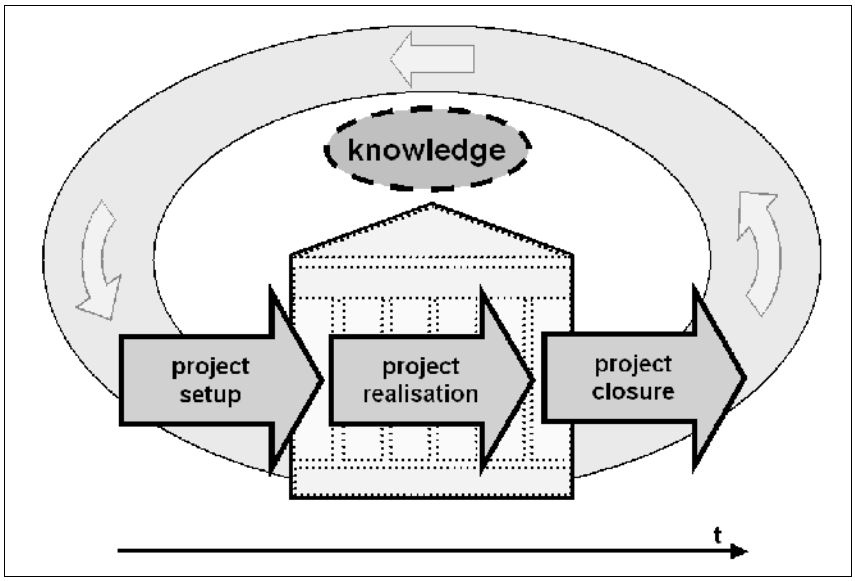

Figure 1: Knowledge Management in Cooperative Projects

One central point, which attracts growing attention, is the major problem of knowledge management under these changed, economical circumstances. Questions of high significance, which have not been sufficiently researched yet, are, how the available knowledge of employees, whose average duration of employment in companies constantly decreases, can be passed on, how new knowledge can be documented and organised and how this could be specifically supported by modern technology.

The Integral Cooperation Model

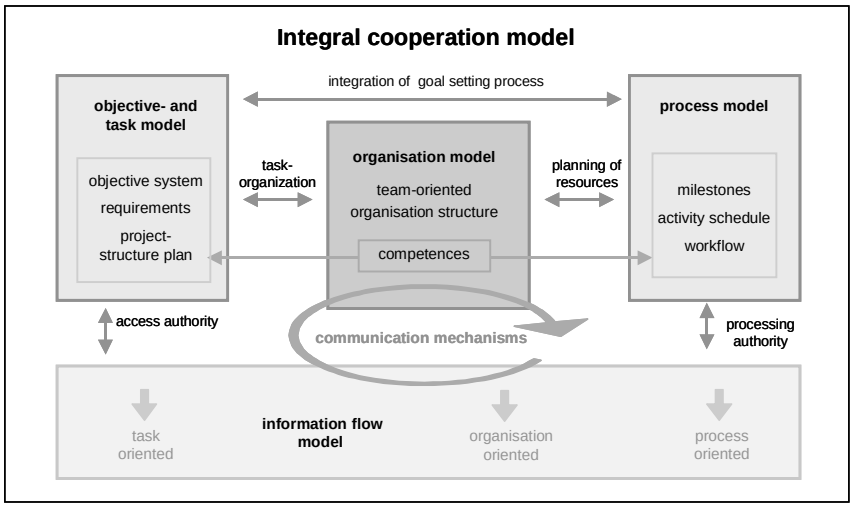

Figure 2: The Integral cooperation model

In order to cope with the integration-approach, the various kinds of problems of project planning (process management, management of tasks and objectives, project organization) will be worked out as partial models and will be integrated into the entire model in consideration of their mutual effects.

Graphic 1 shows the integral model of co-operation with its partial models and their interdependencies [7], [9]. The organizational structure of the co-operation model functions as a link, because a resource-oriented modelling of processes can only be achieved by associating tasks to the corresponding personnel. Furthermore, the responsibilities and the authorization for editing the elements of the partial models will be regulated by organizational roles. The interconnection with the model of information flow is achieved by providing an adequate mechanism of communication and information-logistic structures.

Concept of a Dynamic System of Objectives and Tasks

The fundamental basis of project-planning represents a system of objectives, that enables a conversion of abstract specification of objectives in early project phases (general strategic objectives of the customer) via tactical sub-objectives to operative sub-objectives and tasks [2], [8].. Furthermore, it is intended to give support to the structuring of objectives without being prematurely fixed due to intense standardisation of the subjects [3]. A phase-related structuring and adaptation of the objective system as well as the derivation of the single tasks enables high project dynamics to be handled and available knowledge to be included.

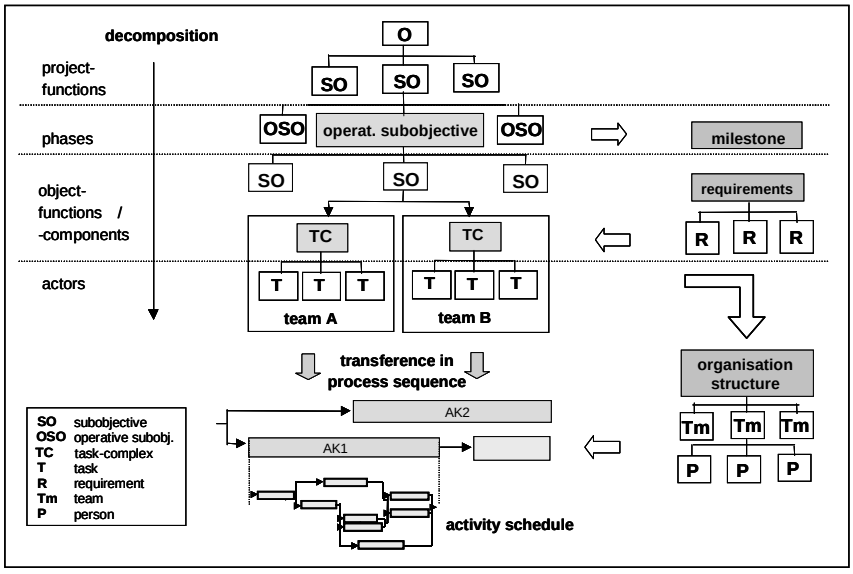

Figure 3: Structure of the objective and task system

To consider problems of the respective object planning as well as project-management, a substructure is created on the upper level of the structure plan according to project functions. The result-oriented tactical goals will be in the frame of objective-planning transformed into operative sub-objectives, which can now be clearly related to a project-phase according to their scope of function. Hereupon a decomposition of the partial objectives is chained onto and oriented around object-components and functions, which finally ends in the derivation of so-called task-complexes.

These task complexes contain interdisciplinary problems, which are closely connected with regard to the contents, as they refer to the same object-component or function. They establish therefore, the reference that forms the organisational structure (planning-teams) within the project.

Organisational Structure of the Model

The phase-related forming of the organisational structure into task-oriented teams offers high flexibility and a dynamic reorganisation, as it results from the topical project situation, which could not be rigidly planned in advance at the beginning of a project. The individual teams have their own responsibility for solving their specific problems as well as the assumption of responsibilities of the team-management within the frame-conditions of the entire project. The distribution of these team-oriented management-tasks is governed by „management by competence " [4] in accordance with the method and social competence-profile of the team members.

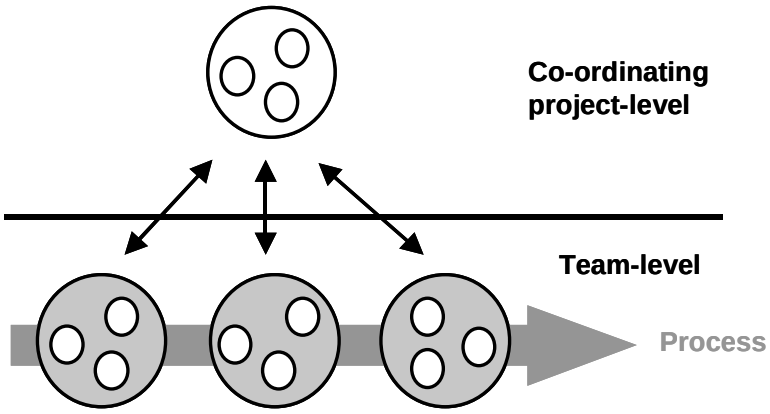

Figure 4: The two levels of management

This disposition of co-ordinated self-organisation in the teams influences the concept of the whole project-management, as the co-ordination has to be done on two levels:

- On the level of the project, the project-function guarantees as organisational roles the co-ordination of the management-tasks.
- On the level of the teams, this is accomplished by the so-called team-function.

The following fields of management will be distributed via these functions:

- Project- and team management
- Project planning and controlling
- Content co-ordination
- Coaching and moderation

Dynamic Model for Process Support

The realisation and adaptation of the system of objectives and tasks within the respective phases and the following transformation of the packages of work into a process sequence permits a comprehension of the high dynamics of planning in the process model as well.

The adjustment of the process course [5] will be done on two levels:

- The result-oriented Co-ordination level
- The activity-oriented detail level

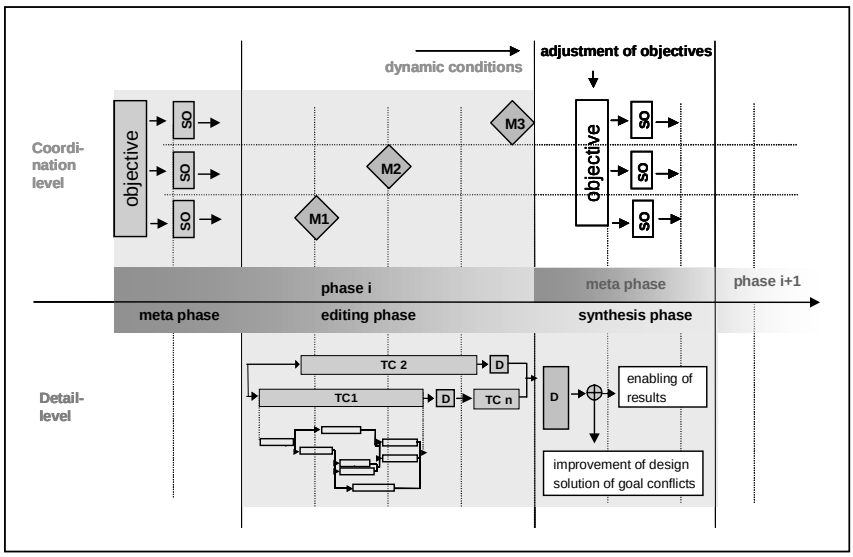

Figure 5: Structure of the objective and task system

On the level of co-ordination, creating phases carries out a coarse structuring of the project. Here the association with milestones, which are derived from operating sub-objectives, offers a survey over the course of the whole project and serves as a co-ordinating frame for the planning on the detail-level

On the detail-level the task-complexes will be transferred into so-called frame-processes worked up in an interdisciplinary way. They form the co-ordinating frame for the single planning processes inside the team and for the co-ordination of the work of the teams among themselves.

After the assessment of the effort and the predefinition of the competencies, the single packages of work will be transformed into logically linked operational processes in a team. These represent the smallest from outside assigned units and will be handed over to the participants as their own responsibility, which leaves them liberty in the choice of their methods. Through this assignment, measures for increasing quality and effectiveness inside the team can be initiated, because the highest competence for the strategy of solving the problems lies there.

Before the end of the phase, it is checked through decision-processes across team boundaries, according to whether the results of work within the different teams represent an overall result according to the main objective and can be used as a base for the next phase. If the concept is not adopted for the next phase, conflicts are resolved through an objective oriented iteration-cycle.

Concept for the implementation of the project model by an internet based cooperation environment

An internet-based co-operation environment will accomplish the implementation of the model. The user interface, shown in figure 5, displays the project with its different phases as well as the various elements of the platform, into which the modules of the partial models are integrated. Beside the provision of various levels of view (phases of project – entire project), personal and process oriented filters offer problem related specific views to the respective elements.

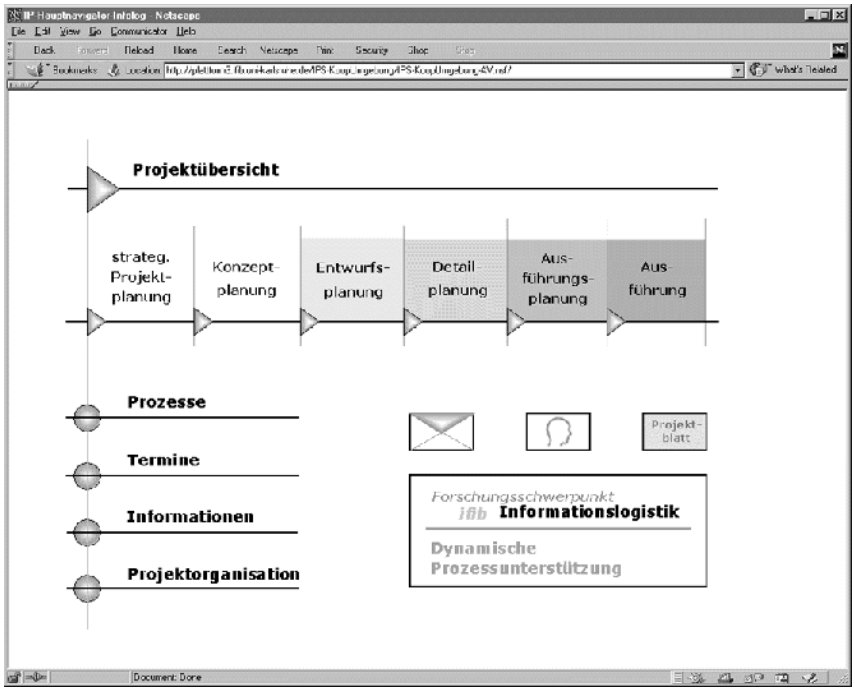

Figure 6: The GUI of the co-operation platform

Module for process management

In the software module „processes“ - based on the transformation of the packages of work into a process sequence - the management of the processes on co-ordination and detail-level takes place. A visualization of the processes over Gantt charts offers here a fast overview of the planning processes

In addition to the administration of all process-relevant items such as phases, milestones and processes, the module offers support regarding an team-oriented methodology for the development and adjustment of the process logic. At run-time appropriate communication mechanisms, e.g. notifications for a change of process dates, support the co-ordination of the processes.

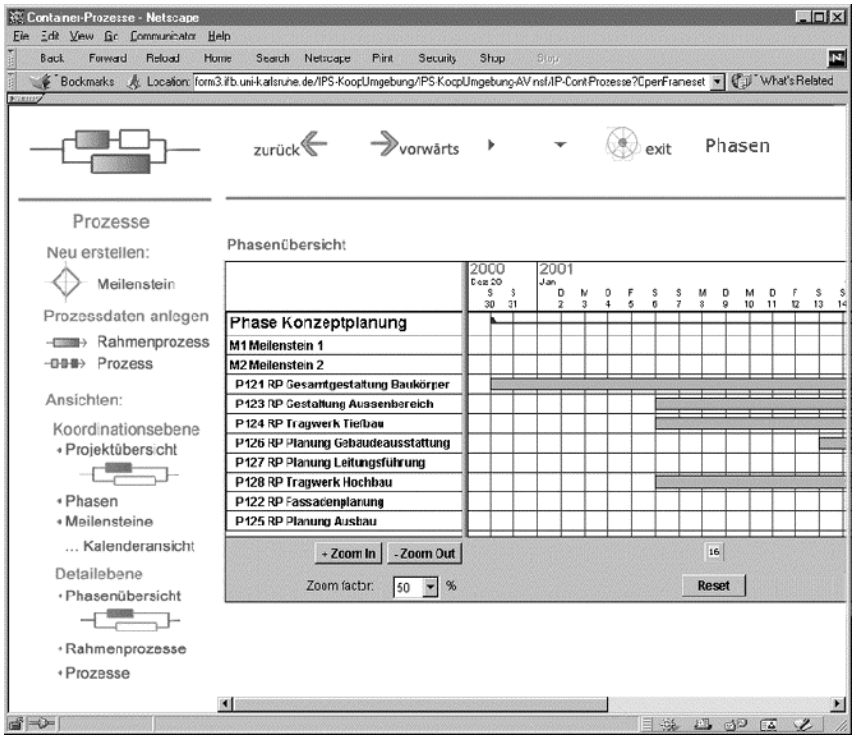

Figure 7: The module for process management

Task- and process-oriented Information Management

This module allows a structured management of all project-relevant information. Thereby meta information are assigned to the actual documents, over which a meaningful classification and the generation of user- and process-oriented views of the information is enabled. Figure 12 shows the information container with an view of planning-relevant information categorized according to the type of the documents.

Concept of an integrated Knowledge Management

Especially in cooperative projects, where various enterprises strike together for a corporate, economic goal and share their resources and competence, it is of fundamental importance to constitute common standards for business processes, communication and personnel organisation. General rules have to be verbalised, how to acquire knowledge for cooperative projects, how to use it during the realisation and how to deal with it after the project's closure. The Institute for Industrial Building Production, Prof. Niklaus Kohler in Karlsruhe, Germany (Institut für Industrielle Bauproduktion –ifib) has set a focus on this recent field of research. The development and advancement of a Cooperation Model have been promoted in numerous research projects. The current activities of the institute concentrate inter alia on the subject, how planning processes in cooperate projects can be structured, modelled, memorised and reused as templates. From our point of view the knowledge-based Cooperation Model is a key to meet the current economical and organisational requirements.

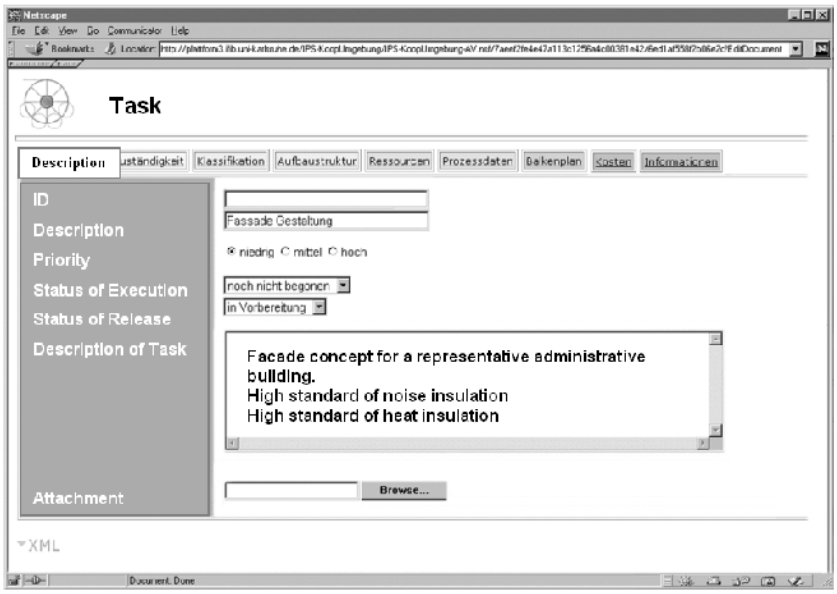

Figure 8: Graphical User Interface – Task Template

In the project "Information Logistics" (Informationslogistik III, 2000-2002), which was developed by five institutes of the University of Karlsruhe, Germany, several of these concepts have been elaborated and realised as prototypical software applications [11]. Subject matter of the project was the procedure of planning nonrecurring, unique projects such as building constructions or production lines by numerous, independent but cooperating partners. It based on the idea, that those creative design projects require a great number of individual skills and resources which have to be merged within an integrated planning process which has to take into consideration the complexness of these projects. But it also embarked on the strategy, that complex planning processes in principle could be structured and subclassified into single personalised and comparable sub-processes. This strategy, based on the prementioned Cooperation Model, enables the involved partners to use the experiences and values from similar projects. Approved processes get stored in a central database and afterwards can be inquired, examined, modelled and optimised. So by establishing und consequently using standards for planning processes it is possible to integrate knowledge management into complex planning processes of unique AEC-projects.

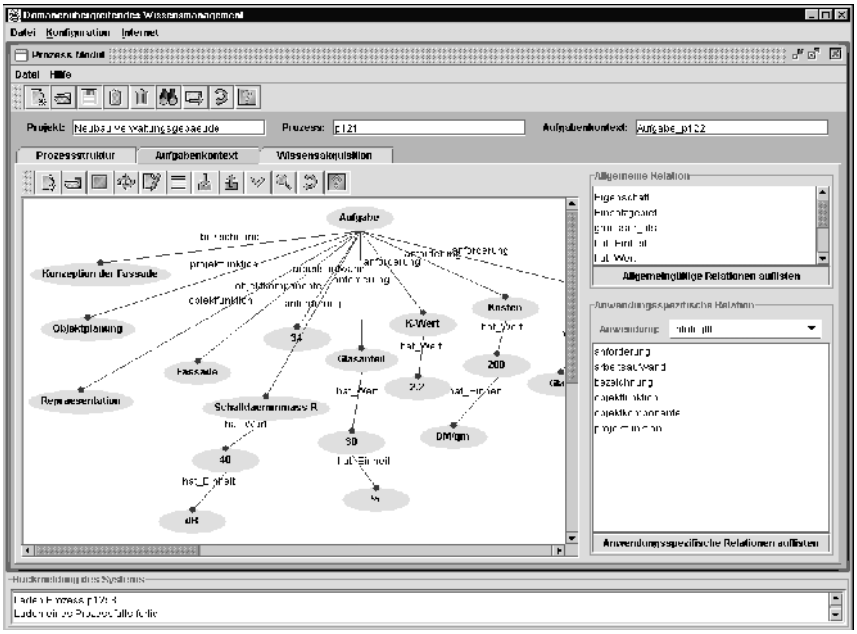

Figure 9: GUI– Request for process proposals, representation of the task's structure, RPK, University of Karlsruhe, Germany

Technical implementation

The implementation of the co-operation environment is based on the GroupWare system Lotus Domino with client/server-system architecture. The domino technology allows flexible access to the database functionality with platform independent WWW-Browser by accordingly transferring requests over the Domino-http-server to the database application and returning the results interpreted in HTML-format. Client requests by HTML-pages, generated by Domino, or by embedded graphical navigators are forwarded directly to the database application or transfer-units (notes agents).

[1] German Ministry for Education and Research:„Gestaltung der Arbeit in virtuellen Unternehmen"; („The Design of Work in virtual Enterprises"), Bundesanzeiger Nr. 5, 2001

[2] Aggteleky, B.: Projektplanung: Ein Handbuch für Führungskräfte; Hanser Verlag, München 1992

[3] Schelle, H.; Reschke, H.; Schnopp, R.; Schub, A.: Projekte erfolgreich managen; Verlag TÜV Rheinland, Köln 1994

[4] Jeuschede, Gerhard: Grundlagen der Führung; Gabler Verlag, Wiesbaden, 1994

[5] Both, Petra von; SCHRAMM, Martin: *Prokoop - Prozessorientiertes Kooperationsmodell für eine anforderungsorientierte dynamische Unterstützung der Integralen Bauplanung* / Institut für industrielle Bauproduktion. Karlsruhe : Universität (TH) Karlsruhe, 2002. – Abschlußbericht. DFG-Schwerpunktprogramm 1103 Vernetzt-kooperative Planungsprozesse im Konstruktiven Ingenieurbau

[7] BOTH, Petra von: Eine internetbasierte Kooperationsumgebung für dynamische und zielorientierte Entwicklungsprojekte, In: *Virtuelle Organisation und Neue Medien*. Köln : Josef Eul Verlag, 2001

[8] BOTH, Petra von; ZENTNER, Frank: *LuZie - Lebenszyklusbezogene Einbindung der Zielplanung und des Zielcontrolling in den Integralen Planungsprozess* / Institut für industrielle Bauproduktion. Karlsruhe : Universität (TH) Karlsruhe, 2002. – Zwischenbericht.

[9] BOTH, Petra von: An Internet-based Co-operation Environment for a Dynamic and Objective Oriented Planning, A contribution for ICCCBE-IX : The 9th international Conference on Computing in Civil and Building Engineering, Taipei 2001

[10] EGGS, Holger; ENGLERT, Jürgen; WELCHERING, Peter; INSTITUT FÜR INFORMATIK UND GESELLSCHAFT, UNVERSITÄT FREIBURG; COMPUTER ZEITUNG: *Electronic Commerce Enquête II*. Freiburg : IIG, 2000. – Empirische Untersuchung

[11] GRABOWSKI, H., DILLMANN, R., KOHLER, N., SPATH, D., SCHMID, D.: *Informationslogistik für internetbasierte Prozessinteraktion bei der branchenübergreifenden Kooperation*. Karlsruhe, Universität (TH), Forschungsschwerpunkt Informationslogistik, Zwischenbericht, 2002