Optimizing Cooperation in Spatial Planning for eGovernment

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Abstract. As a reaction to societal, economic and technological changes, new forms of cooperation are applied in projects of urban and regional development. We argue that this trend can significantly be amplified by the use of information and communication technologies (ICT). Through ICT more persons can participate in a more open, fairer and more transparent way. More complex information can be analyzed, discussions can become more focused, the process is documented and becomes reproducible and comparable. Methods and media can be combined in a very flexible way to design more efficient and effective processes. To the extent that projects are stored in a knowledge base, knowledge management tools can exploit growing experience in order to continuously improve a methodology for cooperation in spatial development. Our approach aims at exploring the opportunities that new ICT offer for new cooperation methods in e-Government and planning - beyond the extension of traditional methods to electronic communication media. It acknowledges the need for experimentation and an evaluation, not only concerning isolated methods but the combination of methods based on knowledge management concepts.

1 Knowledge Management in the Context of Spatial Planning and E-government

This contribution focuses on the possibilities of ICT for cooperative planning processes in the context of e-Government. Mainly three concepts of knowledge management correspond with this thematic area:

First, **intellectual capital** is the basis for cooperative planning procedures, that involve multi-party-processes including public participation. Many stakeholders with various roles and different knowledge backgrounds are the source of the intellectual capital. The concept of “intellectual capital” generally refers to an organization's recorded information (and, increasingly, human talent itself). The term reflects the understanding that information is a growing part of every company's assets, and that such information is typically either inefficiently warehoused or simply lost, especially in large, physically dispersed organizations. The challenge is to find what you have

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and use it. The terms “intellectual capital” and “intellectual assets” appear to have been popular for several years before the term “knowledge management” became popular (Caviedes (1991), cited in: [14]). In this case, the intellectual assets are those of municipalities and other involved stakeholders, as well as the public’s, rather than those of companies and organizations (this circumstance will be further addressed in part 2 of this contribution).

Second, the combined knowledge management concepts of **learning organizations** and **process optimization** are the core elements of the developed methodology for process models (as explained in part 3 of this contribution). The goal of the process optimization concept is to optimize business processes with regard to time, costs and quality through knowledge management. Primarily, it attempts to overcome functional barriers. Topic-oriented networks acquire distribute knowledge across organizations and across business processes. The role of "learning" in business organizations gained awareness with the appearance of Peter Senge's “The Fifth Discipline: The Art and Practice of the Learning Organization” in 1990. Nonaka and Takeuchi's “The Knowledge-Creating Company” (Oxford University Press, 1995) also focused on organizational strategies for creating new knowledge as a competitive advantage (both books cited in: [14]).

Third, the concept of a **knowledge base** is important to the thematic area of cooperative spatial planning processes in e-Government. Knowledge base has traditionally referred to the data produced by the knowledge-acquisition and compilation phases of creating an expert system application. But that definition, too, is now often broadened to include every imaginable corporate intellectual asset. "The knowledge base is the absolute collection of all expertise, experience and knowledge of those within any organization." (Aegiss (1995), cited in: [14]). In the context of this contribution, a central goal is to build a knowledge base under the premise of a certain methodology (see part 4 of this contribution).

Not only the concepts of knowledge management but also the representation of the knowledge is a central question in the positioning of this contribution. According to the specifics of the thematic area, such as cooperative procedures and knowledge sharing as well as documentation, the described research addresses a groupware platform, thus the groupware platform is the medium of knowledge representation.

The second part of this paper describes the nature of the knowledge in the context at hand, and the necessity for the specific knowledge management concepts. The third part refers to how those concepts are to be addressed with ICT usage. The fourth part is a methodology for modeling and optimizing processes in the respective context and the fifth part concludes with some thoughts on further investigation of the problem.

2 Trends in Spatial Development

2.1 Towards Cooperation: Planners as Moderators and Municipalities as Catalysts?

In Germany today, municipalities are used to carry out urban and regional projects in a comparatively closed manner. Input from citizens and stakeholder is feared rather

than welcomed when, by law, these groups are informed first about new development projects - goals, purposes, different options and their effects - and later about the draft of the proposed solution. In both cases, the information is presented at a particular time and place, imposing physical constraints on the participation.

The traditional planning style has deficiencies. Next to formal planning procedures there are informal - and not transparent - decision structures which lead to the loss of confidence between municipality and citizens. In particular when projects have a high potential of conflicts, citizens and groups of stakeholders may form coalitions and take actions to prevent the envisaged solution. This increases the time and costs for implementing the plan. Simultaneously, municipalities are confronted with more information, more uncertainty, less time, less money, and more actors. The complexity is hardly to manage anymore through isolated planning and analysis procedures. This leads to an imminent danger of masking crucial coherences, developments, trends and risks. Additionally, since some years, German municipalities have had to cope with decreasing budgets.

Innovative planning procedures are becoming more important. While traditional procedures aim at legitimating municipal planning, innovative processes focus on effectiveness and efficiency of municipal bargaining. Due to this trend the task of planners shifts from providing finished solutions for planning problems to moderating the planning process between the concerned parties in an innovative and cooperative way. Municipalities outsource parts of development projects to a third party with supplementary competences. In pilot experiments municipalities assume the role of a catalyst that joins the knowledge, resources and commitment of multiple actors, including investors, citizens and local stake-holders. The organization of communication processes between all concerned parties becomes a key factor of successful urban development.

2.2 The Impact of ICT on Sustainable Planning

The internet means information, communication, interaction and transactions almost at any time and from anywhere. Mobile devices achieve ubiquity coupled with new forms of communication, personalized and localized services. ICT is changing the way how companies interact with each other and their customers (e-business) and how governments inform and serve their citizens (e-government). Hierarchical structures are giving way to looser networks of more autonomously acting individuals.

Regardless of the increasing information overload, the term ‘information society’ is gradually being replaced by the term ‘knowledge society’. The construction of knowledge, the availability and application of knowledge and a comprehensive knowledge management determine the way of life and working environment and therefore also modern society to an increasing degree [13].

The upcoming ways of handling knowledge are effective in particular to planning and implementing a sustainable development, which is involved in the solution of diverse social, ecological and economic problems. To account for the three dimensions of sustainability and the complexity of the problems to be solved, the role of networking information and knowledge of heterogeneous actors is to be emphasized. Institutional sustainability can be seen as an additional dimension to be

considered in sustainable development. Co-operative structures and bottom-up approaches of planning form new processes for a democratic sustainability.

A spectrum of more cooperative planning approaches is emerging. Apart from a variety of data and information sources, the knowledge and experience of individual heterogeneous actors is especially relevant. This corresponds to planning theories which regard the development of a common problem viewpoint through the participation and integration of heterogeneous actors as a central prerequisite for mastering complex problems of planning [15], [17], [10].

A recurring theme in urban cooperation projects is the need for a high quality of process management, auditable and accountable processes, and a moderator as a neutral party. The required new skills may be contributed by external project steering offices. Among these skills, practical ICT competence may even become a competitive advantage.

2.3 Baseline for Cooperation and ICT in Spatial Development

In 2002 a new government-supported program called 3stadt2 was launched in Germany. Within the following 2,5 years five model cities will apply new cooperation styles between municipalities, investors, citizens and other actors in selected projects. Accompanying research aims at a systematic characterization of cooperative approaches as a basis for guidelines to optimize cooperation in urban development, to quantify the added values with respect to all dimensions of sustainability and thus obtain tangible arguments for this approach.

While valuable and important results may be expected from the 3stadt2 program, it is surprising that ICT is not taken into account explicitly. Indeed, up to now software in urban development projects has been dedicated to experts and is often lacking integration. For example, Batty (1995) [2] devised an integrated planning support system that is still being promoted because it combines manual and software-supported work [8]. His scheme includes urban IS, GIS (geographic information systems), spread sheets, expert systems, optimization tools and scheduling, but no software for group work like problem and goal definition, bargaining, delphi methods, brainstorming, group decision support, consensus building. As the German e-government initiative [3] is obliging municipalities to put information and services on the internet, installations of Lotus Notes, Microsoft Exchange or other software technology for information, communication and interaction in urban administrations are turning up.

Recent projects in Germany emphasize technical aspects of integrating cooperation support software. At CORP 2002 a Lotus Domino server was presented that shall offer web access to an urban information system, a library of documents and a discussion forum [6]. The data shall be transferred from Domino to relational data bases in order to perform automated analyses.

Our own work takes a socio-technical stance. It began with GeoMed (1996-1998), a European research project that proposed a web-based solution combining groupware for cooperation and participation with spatial visualization tools. Empowerment of all was one goal. The software had to be easy to handle so that all participants could analyze the available information to the individually desired depth.

Since GeoMed, we have continuously improved our software Zeno® for online mediation, e-participation and more generally for moderated electronic discourses. In

the project KogiPlan (funded by the German Government from 2000 - 2003) the latest version of Zeno has been integrated into a platform for cooperative site planning [21], which additionally includes

- a geo-brokering system for collection of geo-data from heterogeneous sources
- SPIN!, a platform with a variety of methods for data mining [12]
- LoLa for mathematical optimization of spatial allocations [7]
- CommonGIS, for multi-criteria analysis and spatial exploration on the web [1]
- the GIS MapExtreme for high end visualizations

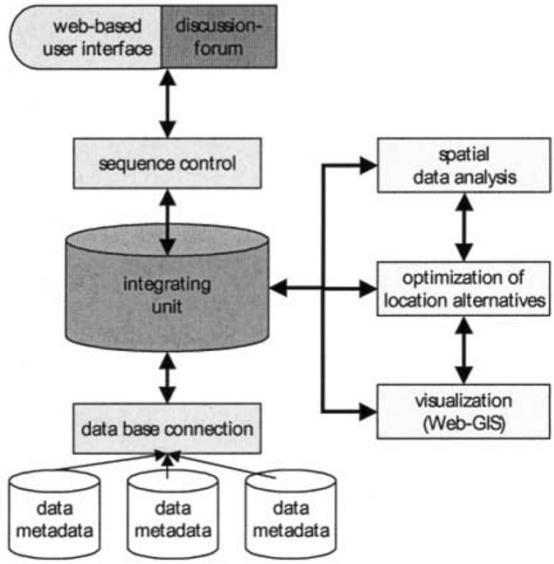

Fig. 1. KogiPlan software architecture for facility allocation

We apply and extend our software to investigate new methods of software-supported cooperation, online, offline and possibly blended with face-to-face meetings. We have accompanied public participation processes [9], carried out role plays concerned with group decision problems [19], [20], [16] and are compiling our experience into a methodology for e-moderation [11].

3 E-cooperation in Spatial Development

3.1 Opportunities

With the introduction of ICT, existing cooperative methods should not simply be copied to the new media without further modifications. Electronic techniques (synchronous or asynchronous, distributed or not, audio-, video or text-based media) can be used for different traditional methods in different phases of the process, and they can be combined in completely new ways, leading to new methods and workflows. Only if this potential of ICT is taken into account by restructuring the

process itself, cooperative planning processes lead to informed high-quality decisions in less time.

- Through e-communication media, more persons can be involved more actively in a planning process. Independent of their location and time participants can read the material provided electronically. Groupware can facilitate their coordination, communication and cooperation, it supports distributed discussions, annotations, reviews, editing and polling.
- Highly connected information, in multiple media, with smart interactive visualization functions, can push information sharing to a shared understanding. All interested participants can interactively explore data prepared by planners and experts - analyze and visualize geographic data and criteria, compare options and their consequences, recognize dependencies, sensitivities, drawbacks and advantages.
- New e-cooperation techniques will combine offline and online elements. Software will enhance traditional face-to-face meetings, conferencing software allows to include dislocated persons or to conduct meetings exclusively over the internet. Shared workspaces and forums enable preparation and follow-up work from different places and at different times. Rigid workflows will give way to moderated, self-organized processes.
- Moderators will be able to combine methods in a highly flexible way in order to focus the discourse and to suitably react to any complications. Electronic questionnaires can turn into electronic interviews or group discussions, and vice versa the issues in a discussion can easily be reorganized into a rationale (a map of options and arguments) and be turned into an online poll. Monitoring software allows to observe ongoing collaboration processes, track interaction patterns, analyze the effects to the moderators' interventions, detect points of conflict or compromise, thus increasing process awareness and allowing to cope with higher complexity.
- To the extent that development processes are conducted or documented electronically, new participants will find it easier to catch-up and join an ongoing project. The processes become more transparent and auditable. When additionally collected in a knowledge base (or electronic warehouse), development projects become comparable, and analytic software can be used to extract patterns, recommendations, guidelines and classifications more systematically. This provides a basis for continuous methodological improvement and optimized use of cooperation methods in urban development.

3.2 Requirements for an E-cooperation Platform

An e-cooperation platform is an ICT solution for urban and regional development processes that provides information, communication and interactions services in a highly customizable way. It should be conceived as part of an infrastructure for e-government and comply to the respective standards [4]. To offer the opportunities described above, the following requirements should be met:

- Virtual offices: To satisfy the basic needs of groupwork - group calendars and directories, shared folders, electronic boards and access to telecommunication

media such as web conferences, chat, forums, etc – virtual offices can be realized by shared workspaces on the web.

- Decision support for the appreciation of criteria and values: Informed decision making is tied to an understanding of the space of options. How do the different options affect the quality of the result and what happens if certain modifications are made, assumptions, weightings or priorities are changed? The quality of an urban design process can be measured by its performance on a number of indicators. These indicators will have to be developed by the community of actors, either in the current project or in preceding projects whose purpose was to develop longer term frameworks and concepts. Long-term indicators and indicators of project-specific values have to be considered together in order to avoid over-reactivity and opportunism. Tools to explore dependencies between indicators and perform sensibility analyses should be easy to use, highly interactive and visual.
- Annotation, review and feedback: It should be possible to comment on any piece of content, in particular reports and plans. The border between comments and discussions should be fluent. Comments may be private annotations, annotations that extend to informal discussions in different groups, or comments may be organized by a moderator as a formal review.
- Surveys: Surveys are a flexible instrument. They can be used very early as a questionnaire to identify important issues. Answers of key persons can feed into a dialog between this person and the planning group. Options identified during a discussion can be come the object of a poll that gives valuable hints on the distribution of opinions. And finally, the same instrument can be used to take an official voting. Whatever their function may be, surveys must be will integrated with the discussion facilities, there should be powerful tools to analyse and visulalize the results.
- Semantic structures: any electronic content, like bits of information, parts of multimedia documents, pieces of communication, comments, components of models and plans, spatio-temporally referenced objects, should be embeddable in a semantic structure. The connections should support association between and automated reasoning about pieces of content. The connections may be labeled, they should be traversable in both directions and they have to be automatically be maintained when the network is manipulated. Nodes and links may be labeled according to dedicated vocabularies, but cooperating groups should be able to evolve the vocabulary and adapt it to their particular communicative needs [18].
- Tools for e-moderation: moderators of electronic discussions should be able to design a cooperative process in detail (participants, roles, beginning and end time, review and publication periods, obligations and rules, etc.). They must be able to monitor and control the discussion process, and to change the setting in a transparent way. Moderators and participants should be aware of the social context: individual contributions of a person, active, passive and absent participants, coalitions and opponents. There should be help to interpret the discussion and identify progress: controversies arising and being settled, chances for compromises, changes of opinions, opening and closing threads, etc.. Switching between methods should be easy, so that moderators can initiate a survey, a review, or a private discussion with selected persons rather spontaneously. Writing summaries, restructuring or editing argumentation structures should be easy.

4 A Methodology Based on Empirical Knowledge

While technological innovation is fast, a methodological understanding – especially on the modeling level – is coming forth only slowly. Due to the extremely complex and interdisciplinary task of planning, the demands upon a methodological framework are very high.

In accordance with the 3stadt2 project, we expect that a methodology for e-cooperation in urban development projects helps to design the cooperation within these projects so as to maximize effectiveness and efficiency. It has to consider the importance of flexible and dynamic composition of ICT-tools and methods, while providing support for a variety of tasks.

A methodology should provide a questionnaire which helps to characterize and consistently plan a project in several dimensions.

- Stages of problem solving: Multi-party problem solving processes roughly follow the phases (1) process clarification, (2) exchange of information, (3) clarification of interests, (4) exploration of options, (5) decision, (6) formulation of contract, (7) implementation [5]. A first group of questions must identify the stages to be covered by the project.
- Degree of cooperation: A project (or a phase in a project) may roughly be qualified as being closed, informative, consultative or cooperative. A second group of questions has to identify for each phase the degree of cooperation and the actors to be involved, possibly even a set of methods. The questions will be concerned with the budget and time frame, the degree of controversy, which aspects are open at all, what competencies and skills are required and available, etc.
- ICT support: The next questions try to elicit for each phase how it could be supported by ICT. A phase could comprise one or more activities, which could run in parallel or sequentially, depending on their input-output dependencies. An activity could be classified as a face-to-face meeting, a synchronous but distributed online conference, or asynchronously. More precisely, for each activity (electronic) media, software tools, and the period could be recommended. Questions in this group concern the number of participants and their spatio-temporal availability, the complexity of the problem and the task, the availability of mathematical models for optimization, simulation or prognosis, the need for accountability and documentation.
- Further groups of questions may elicit further external constraints in order to suitably embed the cooperation process into the organizational environment, and to provide more precise estimates for the expected costs and time.

With the help of the suggestions obtained in this way, a plan for the cooperation in the project has to be elaborated and accompanying measures have to be defined. Figure 2 shows in a simple visualization a part of the process planning procedure for two nearly similar processes. The problem solving stages are identified as well as their corresponding media/tools. Additionally the mode online/offline is indicated. The procedures in this example differ in the choice of Media/tools and in the mode. Figure 2 only illustrates a rough outline of the plan. This visualization does not show detailed information on time-frame, participants, etc., which also should be planned beforehand.

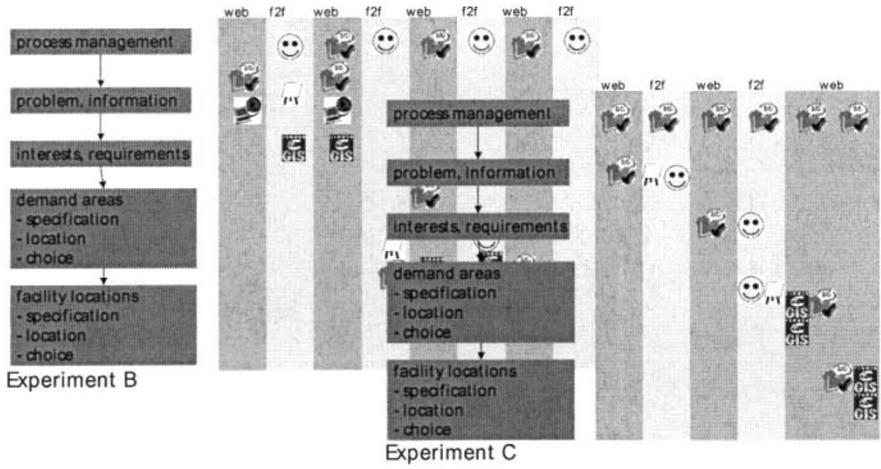

Fig. 2. Process outlines with stages of problem solving, ICT support and cooperation mode

During the project, the plan may be modified and further accompanying measures be undertaken. These deviations, together with the original plan, the "digital trace" and the electronic documentation of the project should be stored in a data repository. As this data base grows with every project, intelligent techniques (indexing, data mining, text mining, case-based reasoning) can be used to analyze, compare and cluster the projects, ultimately to provide hints for improving the questionnaire, and to enrich the guidelines with examples and templates.

5 Conclusions

The presented approach aims at exploring the opportunities that new ICT offer for new cooperation methods. Beyond the extension of traditional methods to electronic communication media, ICT offers new possibilities through flexible process patterns under the premise of a methodology which is based on knowledge management concepts. This approach acknowledges the need for experimentation and an evaluation, not only concerning isolated methods but the combination of methods in a development project. It is essentially socio-technical and requires the a joint effort of spatial planners, sociologists and computer scientists.

The interdisciplinary research may establish and build up the knowledge base upon varying processes. The further research could investigate requirements for a platform which allows for more intelligent techniques (indexing, data mining, text mining, case-based reasoning), to successfully classify the projects beforehand.

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