

What Role Does Visualization Play in Communication with Citizens? – A Field Study from the Interactive Landscape Plan

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Abstract

The potential of the new media to support citizen participation in landscape planning and to improve citizen understanding and acceptance of environmental measures was examined in the implementation and development project (*E+E-Vorhaben*)¹ “Interactive Landscape Plan Koenigslutter am Elm” (<http://www.koenigslutter.de> → Button: *Interaktiver Landschaftsplan*). An online landscape planning system was developed and tested during the development of the landscape plan for Koenigslutter am Elm, an agricultural community in the southeast corner of Lower Saxony, Germany with approx. 17,800 citizens and 17 incorporated town districts.

The investigation of the role of visualization in the communication with citizens during the landscape planning process was central to the project. A wide variety of visualization methods were used to support citizen participation in town meetings and on the Internet platform. In a field study in the district of Bornum, four different visualization methods (sketches, photomontage, VNS-renderings and Lenné3D) were tested during a town meeting and citizens’ reactions to the visualizations were gathered. The objective of the field study was to identify characteristics of the visualization methods that citizens considered important for the understanding and discussion of the planning proposals. The field study and findings are described and recommendations for the use of visualization in the participation process are made.

1 Introduction

Greater public participation in the landscape planning processes is a European political goal supported by the Aarhus Convention and something that citizens have grown to

¹ From April 2002 until February 2005 an interdisciplinary team at the University of Hanover composed of landscape planners, computer programmers and social scientists accompanied the preparation of a landscape plan in Koenigslutter am Elm, which was carried out by the city of Koenigslutter and an independent planning office (*entera*). The project team at the University of Hanover consists of:

Dept. of Landscape Planning and Nature Conservation: Prof. Dr. Christina von Haaren and Dr. Manfred Redslob (project managers), Arne Neumann, Barty Warren-Kretzschmar, Roland Hachmann, Carolin Galler;

Dept. of Applied Systems: Prof. Dr. Erich Wolter (project manager), Karl-Ingo Friese;

Dept. of Open Space Planning and Sociology of Planning: Prof. Dr. Bettina Oppermann (project manager), Simone Tiedtke

expect. The advantages of using computer-generated visualization techniques for public involvement in decision-making have long been recognized (LANGE 1994, HOWARD ET. AL 1996, SCHIFFER 2001). Increasingly, research is addressing the development and use of visualization tools which can effectively support participatory landscape planning (LENNÉ3D 2005, VISULANDS 2005) and the effective integration of visualization into the planning process (LANGE ET. AL 2003, APPLETON & LOVETT 2003). As visualization tools continue to be improved and optimized, the questions remain:

- Which characteristics of the visualizations are crucial for the support of citizen participation in the planning process?
- Which of the visualization methods are best suited for the different landscape planning tasks?
- How can visualization be successfully employed in citizen participation activities, both online and offline, and which organizational aspects are important?

2 Visualization and Participation in the Interactive Landscape Plan

The objective of the visualization in the Interactive Landscape Plan was to help citizens understand the spatial and temporal processes in the landscape, to comprehend the planning proposals as well as to promote communication and interest in the landscape plan. The choice of visualization methods was dependent on the audience, the size of the site, resources, as well as the planning objectives and participatory situation, i.e. Internet, workshop, town meeting (CP. AL-KODMANY 1999). Moreover, in Koenigslutter a wide variety of visualization techniques were tested in order to determine which characteristics of the visualization citizens considered important for different planning tasks.

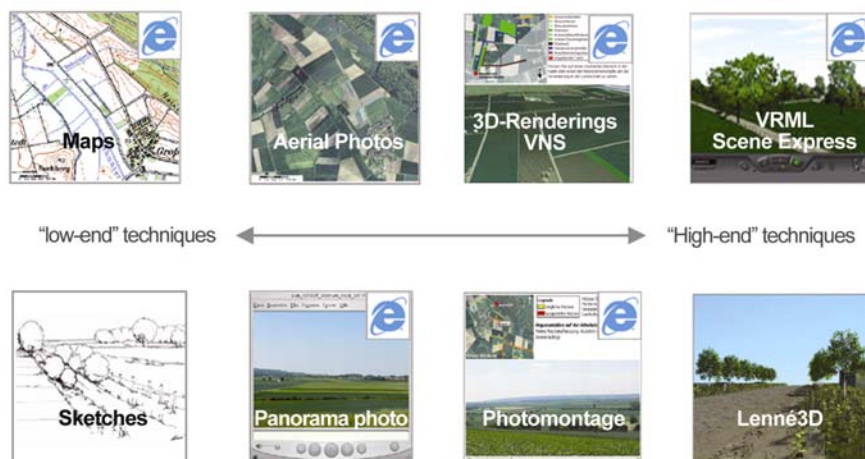


Fig. 1: The visualization techniques used to support the citizen participation

The visualization techniques ranged from 2D methods of landscape visualization, such as interactive maps and digital photomontage, to 3D-models and virtual reality (VR) (See Fig. 1). In cooperation with the Leibniz-Centre for Agricultural Landscape and Land Use Research (ZALF), a prototype of the real-time VR software system Lenné3D² was also tested. The different techniques offered a variety of interactive options and degrees of photo realism as well as different levels of GIS support that are summarized in Table 1.

Table 1: Overview of visualization methods and their attributes

	Dynamic navigation	Interactivity (of image)	Photo-realistic	GIS-supported	Internet
Interactive maps / Aerial photos	+	-	-/+	++/-	++
Panorama photos	+	-	++	-	+
Photomontage	-	+	++	-	+
Sketches	-	++	-	-	-
Rendering of 3D-Model (VNS)	-	+	+	++	+
VRML (Scene Express)	++	-	+	+	++
Lenné3D/ LandXplorer	++	+	++	++	-

Legend: - unsuitable, + suitable, ++ very suitable

During the project an open source layer visualization tool (LaVisTo) was developed to give still images an interactive function, in which parts of the image could be shown or hidden. This allowed the individual planning measures to be turned “on or off” in the visualization (See Fig. 2). An image of the simulated planning measures was prepared with a visualization software (in this case VNS and Photoshop) and images of the individual

²The research project Lenné3D (www.lenne3d.de) is sponsored by the Deutsche Bundesstiftung Umwelt (DBU).

measures were saved in separate files. The tool then produces an interactive HTML version of the image, in which the measures in the overview map were linked with the planning measures in the visualization.

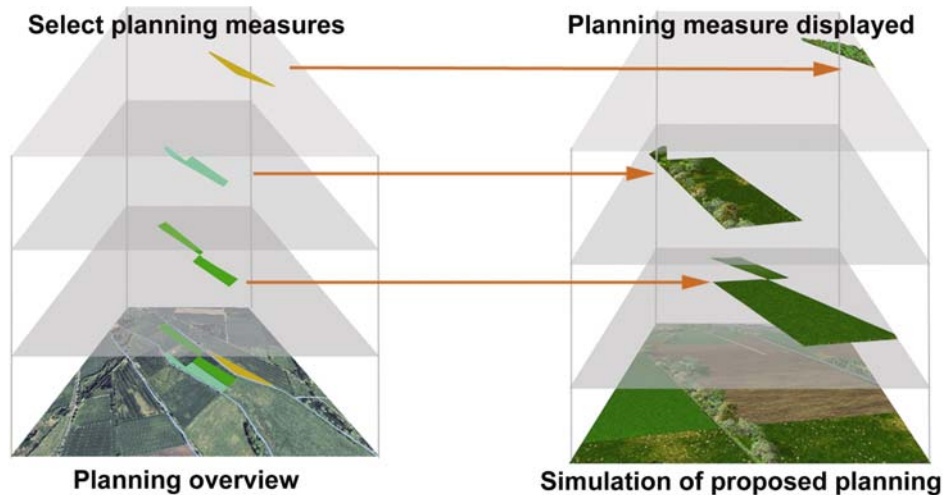


Fig. 2: Still images are made interactive with LaVisTo.

2.1 Citizens Participate Online and Offline

An **Internet platform** as well as “**participation projects,**” which focused on specific local environmental issues, formed the basis for information, communication and participation with citizens during the planning process in Koenigslutter. The participation projects provided the opportunity to discuss topics that were relevant to both the planners and the public, such as a bicycle path concept, visual quality issues, soil erosion and the renaturalisation of a local floodplain (See Fig. 3). Citizens could participate in town meetings, excursions, seminars and working groups in which visualization techniques were tested and their effectiveness examined.

Throughout the landscape planning process, interactive maps of the most recent GIS data of the landscape plan were visualized in the Internet using the UMN MapServer. Citizens were encouraged to review the data online during the inventory and analysis phase and to make comments and corrections as well as to make comments on the completed draft of the landscape plan and report using a web-based participation tool that was developed for the project.

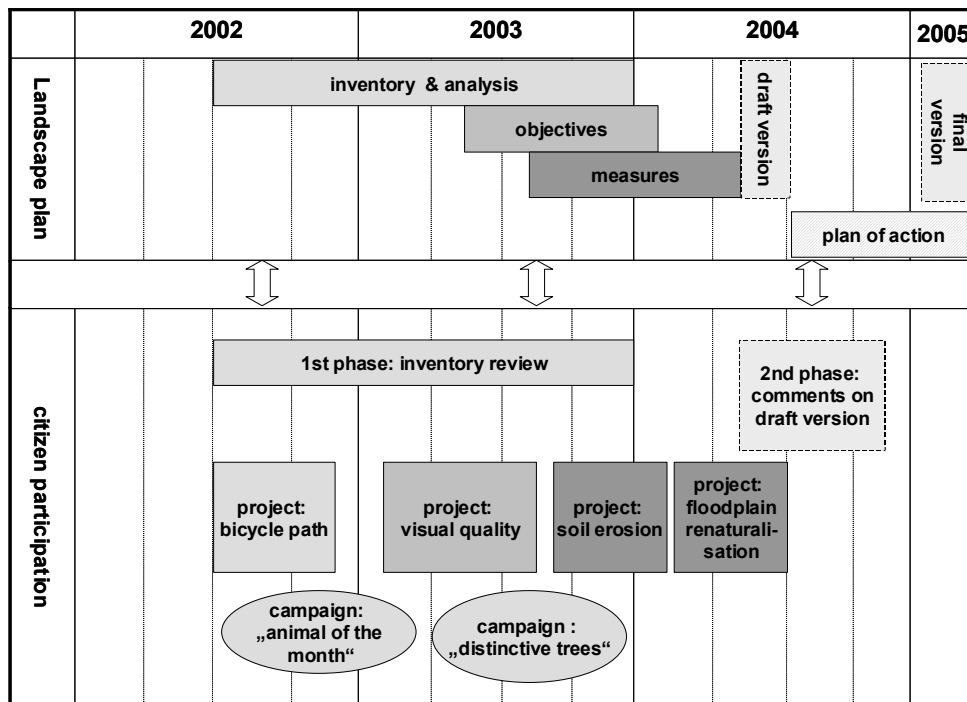


Fig. 3: Structuring of the participation process in Koenigslutter in phases and projects

2.2 Visualization Supports the Participation Projects

Visualization served a variety of functions throughout the participation projects that included illustrating background information, acquiring local knowledge and citizen opinions as well as supporting presentations and discussions in town meetings (See Table 2). The participants’ reactions to the various visualization methods were recorded with questionnaires, interviews, and participatory observations (OPPERMANN & TIEDTKE 2004). Furthermore, the visualization supported the documentation of the planning information and the results of the citizen participation in the Internet.

In the participation project “**visual quality**”, citizens from two Koenigslutter districts, Rottorf and Groß Steinum, had the opportunity to express their opinions about landscape preferences and problems in person, as well as virtually, using panorama photos and an opinion questionnaire in the online discussion forum. In a community meeting, citizens discussed the visual effects of proposed hedgerows on the landscape using an interactive photomontage in which proposed hedges could be displayed or hidden. Afterwards the visualization was accessible in the Internet and used to document the consensus of the discussion. Citizens also simulated their own vision of the landscape in a hands-on workshop using photomontage techniques.

Discussions with farmers about soil conservation methods were the focus of the participation project “**soil erosion**” in the **Bornum** district. Planners developed scenarios

that were simulated with four different visualization techniques and used to support discussions in a town meeting with interested citizens and farmers. This town meeting provided the setting for the comparison of citizens' reactions to the different visualization techniques and is described in more detail in section 3.

Finally, a concept for the renaturalization of the Schunter river and surrounding floodplain was discussed in the participation project **“renaturalization”**. In a town meeting a film presented the local situation and the opinions of various interest groups about stream renaturalization. Using VNS, an overview of the planning area was visualized and linked to “before and after” images of the planning measures. The presentation of the proposed planning in the town meeting was also supported with a tour through a VRML model that simulated the site conditions in 15 years.

Table 2: Overview of visualization methods used in the participation projects

Topic	Objective of the visualization in the citizen participation	Visualization method	Town meeting	Internet
Project: Visual Quality (Rottorf, Groß Steinum)	Determine citizen preferences of landscape types and develop planning alternatives with citizens	Panorama photos	X	X
		Interactive Photomontage	X	X
		„Hands on“ workshop: citizen-generated photomontage	X	
Project: Soil Erosion (Bornum)	Visual support for the discussion of planning alternatives	Panorama photo		X
		Sketches	X	
		Photomontage (interactive)	X	X
		VNS (interactive)	X	X
		Lenné3D	X	
Project: Renaturalization (Beienrode)	Simulate visual and spatial effects of planning proposals	Film	X	X
		VNS	X	X
		VRML (Scene Express) – VR 3D-Model	X	X

3 Field Study in Bornum

In a series of meetings during the winter of 2003/04, farmers and planners discussed the problems of soil erosion in an agricultural part of the Bornum district. Based on the information gathered from the local farmers, planners prepared scenarios for the area that incorporated soil conservation and nature protection goals. In March 2004 farmers, interested groups and citizens were invited to discuss the scenarios in a town meeting. In preparation for the discussion, the planning scenarios were simulated using four different

visualization methods which offered a variety of navigation possibilities, interactivity and photo realistic qualities:

- **Sketches**, which can be considered a low-end interactive method of visualization, were drawn from four locations that combined a bird's eye view of the planning measures with more detailed eye-level drawings of specific areas in the eastern half of the site. The artist prepared black and white line drawings on paper (size: A2) of the existing site conditions and, in a second set of drawings, rendered the proposed planning measures in color. During the discussions the artist sketched the suggestions made by participants on tracing paper which was hung over the drawings.
- A **digital photomontage**, created from a 180° panorama photo of the site, simulated the planning measures on the western half of the planning area. In the preparation of the photomontage, LaVisTo was used to link the individual measures with an overview map in which the planning measures could be interactively displayed or hidden. This limited interactivity allowed participants to compare the existing site conditions with the simulated proposed planning measures.
- The program **VNS** was used to create **3D renderings** of the simulated planning proposals in the western half of the site. A 3D-landscape model was generated from on a digital elevation model (DEM) and GIS habitat data, and vegetation and structures in the model were visualized using textures, 3D-objects and billboards. In addition to "before and after" images from different viewpoints, an overview of the planning measures was rendered and prepared with LaVisTo, so that measures, either individual or in groups, could be "turned on and off".
- A prototype of the **Lenné3D system** visualized the eastern portion of the site with the interactive 3D-map editor (LandXplorer) which navigated a 3D model generated from a DEM, high resolution aerial photos as well as historical land use and habitat information. Using the 3D-map editor citizens' comments could be interactively located in the landscape model during the discussion with keywords, lines and polygons. In addition Lenné3D's 3D-player provided citizens with a virtual reality experience, in which the distribution of detailed, botanically correct plant models were visualized in real time for a 1.1km² portion of the site.

The visualizations were set up at four different stations (See Fig. 4), and a technician familiar with the visualization technique was available to present the visualization during the small group discussion. At each station aerial photographs and large topographic maps which showed the location of the planning measures were used to record comments and, when necessary, help participants to orient themselves during the discussion.

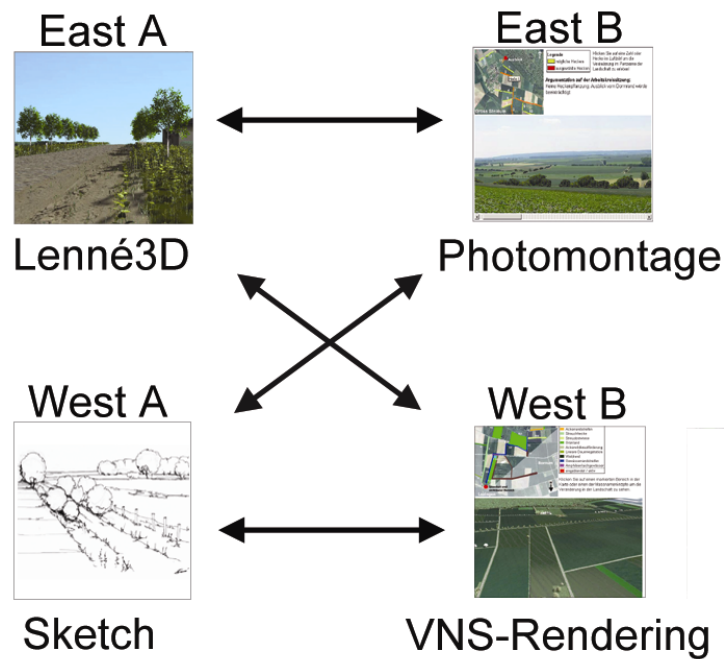


Fig. 4: Four visualization stations at the town meeting in Bornum.

After a general introduction to the nature protection scenarios and presentation of the agenda for the evening, the 30 participants were divided randomly into four groups and directed to one of the stations where the group discussed the scenarios for 20 minutes before moving on to the next station. Each group had a moderator and an observer as well as an expert available to answer questions about the planning proposals. The moderator and observer stayed with the group as they moved around the stations. The observers recorded how the participants reacted to the visualization and how they used the visualization during the discussion. After rotating around the four stations, the participants had time to fill out a questionnaire and discussed their reaction to the different visualization methods before the results of the small group discussions were presented and discussed in the plenum.

Field study results

In addition to the short questionnaire, the reports from the four moderators, four observation protocols, and reports from the technicians formed the basis for the analysis of the participants' reactions.

- **Interactivity and flexibility were requested**

The citizens welcomed the visualization and used it actively in the discussions to locate their comments and to illustrate or emphasize their ideas. The possibility to view different

perspectives of the landscape was important in the communication with the citizens. Participants instructed the technicians to pan to certain areas, or they wanted “to go” to a specific place in the visualization and were disappointed when it was not possible. The citizens also commented that the visualization helped them to understand the “where” and “what ” of the proposed planning measures. Repeatedly, citizens wished to see their own ideas visualized immediately or to make changes to the existing visualization. During the discussion citizens frequently made use of the possibility to „turn” individual planning measures “on and off“ in the photomontage and VNS simulations. Some participants found the comparison of the current and future status of the planning essential for their assessment of the proposal. The comparison of planning alternatives and conditions provided an important method for helping citizens understand and evaluate the effects of the proposed measures and constitutes a minimum requirement for the interactivity of visualization systems. Also, the interactive capability of Lenné3D to locate comments, polygons and objects in the 3D-map was actively used in the discussion and is a promising development in participation-based visualization.

- **2D supports orientation**

The participants were very familiar with the planning area, nevertheless, 2D maps and aerial photos with recognizable landmarks were important orientation tools for the citizens and they provided a good means for documenting the participants’ comments. On the one hand, citizens asked to see the planning from different perspectives. On the other hand, many citizens found that the rapid navigation through the 3D-model was difficult to follow and they became disoriented. This supports the findings in transportation planning that participants preferred static 3D images to VR representations (BAILEY ET. AL, 2002) and illustrates the importance of understanding the participants’ experience with the visualization.

- **Realistic but not too (photo) realistic**

The farmers in Koenigslutter expected a (photo) realistic representation of the status quo, questioning the data source and paying close attention that the details of the visualization portrayed the existing site conditions. When details did not agree with their knowledge or perception of the site, farmers were sceptical of the validity of further visualizations and accused the simulations of making the planning “look good”. Although some of the details of the visualized scenarios were criticised, e.g. seasonal inconsistencies of flowering trees or “standard” hedges, the disagreement about the details did not prevent citizens from understanding and discussing the content of the planning proposals. The detailed, accurate visualizations made clear exactly which citizens were affected by the planning measures causing, in some cases, heated discussions with individual landowners. The challenge remains to find a level of detail for the visualization which sufficiently illustrates the planning, but which also conveys the process-oriented character of planning.

- **More challenges for moderators**

The use of the visualization in the town meeting offered the moderators an extra challenge. In addition to directing and documenting the discussion, the moderators coordinated the various visualization tools during the discussion. (In Bornum a technician was responsible for the presentation of the visualization so that the moderator could concentrate on the

content and progress of the discussion.). Despite the predominant presence of the visualization during the town meeting, the visualization never dominated or determined the direction of the discussions. However the visualization could not support topics that were not related to the specific planning measures, e.g. agricultural subsidies.

4 Conclusion and Recommendations

The experience showed that citizens actively used a variety of visualizations in the participation process. The available visualization methods supported many of the planning tasks, however the “wish list” of both planners and citizens suggests areas in which visualization techniques can be developed in order to better support citizen participation in landscape planning.

- Participants who were excited by the visualizations were often disappointed that the technology did not support the possibility to visualize their suggestions or planning ideas immediately. Flexible visualization techniques that can interactively visualize new ideas or edit the existing visualization “on the fly” would be an asset in the communication with citizens during the planning process. Such visualization tools could help citizens express their thoughts as pictures, helping them to become active participants in the planning discussion.
- Citizens would have liked to see the development or progress of the planning measures over time. In Koenigslutter participants had to suffice with “before and after” images of the planning, but 4D visualizations that demonstrate the long-term effects of planning proposals and temporal landscape processes would offer citizens an understanding of landscape processes which 3D visualizations can not.
- The visualization methods used in Königsutter required the planner to specify the details of the planning measures well in advance so that simulations could be generated prior to a town meeting. However, planners would have preferred flexible visualization techniques that allowed them to develop the specifics of the planning measures with citizens during meetings. Planners also requested visualization techniques that support the iterative character of the planning process and illustrate invisible or incremental landscape processes, such as soil erosion, which are often difficult to explain to citizens. Such conceptual representations of the landscape and their use in the planning require further research and planners need to formulate criteria for the development of suitable software applications.
- Finally, it remains unclear exactly how often and with what kind of success the visualizations were used over the Internet platform. This aspect of visualization in the participation process deserves further investigation.

The choice of “where” and “what is visualized” focuses attention on specific planning locations and issues during the participation process. Therefore, these decisions need to be transparent, and when appropriate, citizens should be included in the decision process. It

then becomes the task of the planner to determine which visualization methods best support the participation. The investigation in Koenigslutter showed that the citizens placed diverse requirements on the visualization which could only be fulfilled through a combination of visualization methods. For example, citizens preferred 2D maps and aerial photos for orientation and documentation of their comments during the discussion. But they took advantage of the dynamic navigation offered by Lenné3D's 3D-map editor to view the site from different points of view, thereby improving their spatial understanding of the planning. And the participants used the comparison of the "before and after" visualizations of the planning scenarios to assess the visual effects of the proposed planning measures. Furthermore, the choice of visualization methods and their effective integration into the planning and participation process requires good project management that coordinates the planning and visualization requirements. Finally, the moderator plays a crucial role in the successful integration of the visualization during the discussion. In order to ensure a smooth presentation of the visualization, an assistant responsible for the demonstration of the visualization as well as a "dress rehearsal" are indispensable.

5 References

- Al-Kodmany, K. (1999): *Combining Artistry and Technology in Participatory Community Planning*, Berkeley Planning Journal, 13: 28-36
- Al-Kodmany, K. (2002): *Visualization Tools and Methods in Community Planning: From Freehand Sketches to Virtual Reality*, Journal of Planning Literature, 17: 27-35
- Arnstein, S. (1969): *A Ladder of Citizen Participation*, Journal of the American Institute of Planners, 35: 216-224
- Appleton, K. & A. Lovett (2003): *GIS-based visualisation of rural landscapes: defining 'sufficient' realism for environmental decision-making*. Landscape and Urban Planning, 65: 117-131
- Bailey, K., J. Brumm & T. Grossardt (2002): *Integrating Visualization into Structured Public Involvement: A Case Study of Highway Improvement in Central Kentucky*, Paper presented at 81st Annual Transportation Research Board Meeting, available online: <http://trb-pi.hshassoc.com/publications/02-3113.pdf>
- Howard/Stein-Hudson Associates, Inc. (1996): *Public Involvement Techniques for Transportation Decision-making*, U.S. Department of Transportation. Publication No.: FHWA-PD-96-031, available online: <http://www.fhwa.dot.gov/reports/pittd/cover.htm>
- Lange, E. (1994): *Integration of Computerized Visual Simulation and Visual Assessment in Environmental Planning*. Landscape and Urban Planning, 30: 99-112
- Lange, E. (2002): *Visualization in Landscape Architecture and Planning: Trends in GIS and Virtualization in Environmental Planning and Design* (Eds. Buhmann, Nothelfer, Pietsch): 8-18
- Lange, E., O. Schroth & U. Wissen (2003): *Interaktive Landschaftsentwicklung*. DISP, 155: 29-37
- Lenné3D (2005): <http://www.lenne3d.de/>

- Oppermann, B. & S. Tiedtke, (2004): *Zweiter Zwischenbericht, Wissenschaftliche Begleitforschung zum E+E-Vorhaben „Interaktiver Landschaftsplan Koenigslutter am Elm“*, Zeitraum: Juni 2003 bis Juni 2004 (unpublished report)
- Sadagopan, G. (2000): *Web-Based Geographic Information Systems: Public Participation in Virtual Decision Making Environments*. MastersThesis, VPI. Blacksburg, Va., available online: <http://scholar.lib.vt.edu/theses/available/etd-05232000-11100031/unrestricted/MajorPaper.pdf>
- Schiffer, M. (2001): "*Spatial Multimedia for Planning Support*" in *Planning Support Systems*. Brail, R. & Klosterman, R. (Eds.): *Planning Support Systems: integrating geographic information systems, models and visualization tools*. – Redlands (ESRI Press): 361-385
- Smyth, E. (2001): *Would the Internet widen public participation?* Unpublished MRes Thesis, University of Leeds
- Steinmann, R., A. Krek, T. Blaschke (2004): *Can Online Map-Based Applications Improve Citizen Participation?* proceedings TED Conference on e-Government, Bozen 2004, available online: http://map3.salzburgresearch.at/docs/291104_bozen_last_springer_web.pdf
- Visulands - Visualization Tools for Public Participation in the Management of Landscape (2005): Change, Visulands Project, ETH Zürich: http://lrg.ethz.ch/visulands/fs_visulands.html
- 3D Nature: <http://www.3dnature.com/>