Landscape planning and GIS-based data management

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Abstract

Landscape Planning in Germany is based on the recently amended nature protection law. Municipalities and districts are required to draw up plans that represent the status and the future development of nature and landscape. The quality of the plans mostly depends on the quality of the gathered data and the quality of ecological evaluation methods applied. Geomatics could support the planning process, visualisation and implementation of the plan. This paper presents experiences gathered during the development of the planning viewer "PLANalyst" based on Map-Objects lt. 2.0 and Visual Basic 6.0. It also gives further prospects on the required data management with ArcGIS to improve the landscape planning process and landscape monitoring in Germany.

1. "Landscape Planning" – a multi-sectoral planning task

Despite the fact that it combines ecological knowledge with cross-sectoral land use concepts and protection strategies, "landscape planning" in Germany is a discipline in itself. It has to be seen separately from the internationally used term of "landscape management". Landscape planning in Germany has its own history and regulatory basis, established by the federal nature protection law of 1976. It is embedded into the German spatial planning system as a three tier, sectoral planning task with a broad range of objectives. First of all, it is a precautionary planning instrument used for nature conservation and landscape management to promote comprehensive protection of the natural environment and its ecosystems and to develop the natural environment according to its specific needs (BfN 2003).

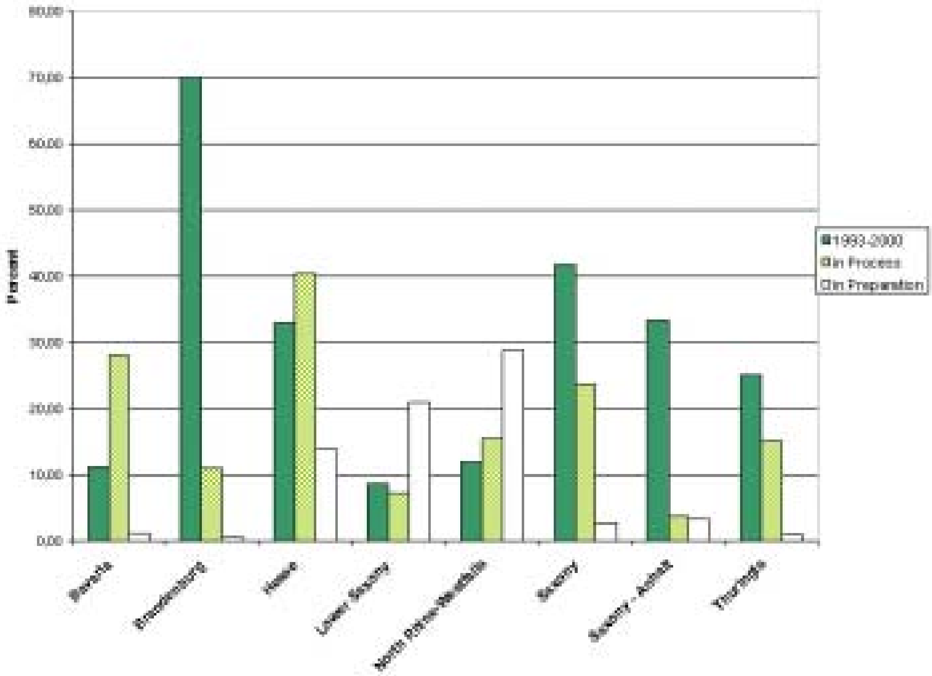
Modern landscape planning in Germany is based on the nature protection law that was amended in 2002. This framework legislation outlines the nature protection law of the federal states. According to the new legislation, municipalities and districts are required to draw up plans that represent the status and the objectives and the measures for the potential development of nature and landscape. Landscape plans identify, evaluate and represent the current functional capacity of the various factors (air, climate, soils, biodiversity, water and groundwater) of the natural environment. Proceeding from guiding ideas and development concepts, landscape plans formulate measures to be implemented by planning agencies and, where appropriate, by conservation authorities in pursuit of their nature conservation responsibilities.

The fundamental amendment of the nature protection law was originally influenced by requirements of EU-guidelines and regulations such as the 'Habitats Directive'[1] and the 'Water Framework Directive'[2] which had to be implemented into national legislation (BFN 2002). However, the previously existing regulations of landscape planning also had a number of weaknesses and deficits. For this reason, landscape plans never played the role in municipal development that they were originally intended for. Looking at figure 1, it becomes clear that the municipalities of the federal states of Germany have great deficits in drawing

[1] European Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
[2] Directive 2000/60/ec of the European parliament and of the council of 23 October 2000 establishing a framework for Community action in the field of water policy

up landscape plans. Only the municipalities of the federal states of Brandenburg and Saxony claim an appreciable share of current plans (BFN 2003, SCHAAL 2004).

Figure 1: Number of municipalities with actual landscape plans in selected federal states of Germany



Source: SCHAAL (2004)

The reasons for this situation have been discussed broadly in the scientific community and it seems to be clear that the lack of political acceptance, the planning costs and methodological uncertainties are the main factors responsible for the deficits (KIEMSTEDT AND WIRZ 1990). It has also been proven that the quality of the plans depends strongly on the quality of the gathered data and the quality of the applied methods to evaluate the ecological status of the planning area.

2. Geomatics and landscape planning

But why should we encourage the use of geomatics in landscape planning? Regarded from a scientific point of view, geomatics is the science and technology of gathering, analysing, interpreting, distributing and using geographic information. Geomatics encompasses a broad range of disciplines that can be brought together to create a detailed but understandable picture of the physical world and to evaluate the human influence on it. These disciplines include surveying and mapping, remote sensing, geographic information systems (GIS) and global positioning system (GPS) (BILL 1999; BILL AND FRITSCH 1999). Each of these disciplines are used in landscape planning, because geomatics and landscape planning are an application-orientated science with a standardized sequence of work steps, which include

- the gathering of data,
- the data management,
- the analysis and evaluation of data,
- and the presentation of the analyses´ results.

ASCHE & SCHREIBER et al. investigated the use of GIS in environmental science and in landscape planning in Germany (ASCHE/SCHREIBER et al. 1999) and they came to the conclusion that all working-fields of landscape planning can be selectively accompanied by the use of GIS. In particular, conflict analysis is supported by GIS. But there are also great deficits in using the available GIS-technology and GIS-functionality in planning practice.

Complex analysis and the application of specific models, developed and used in research projects, are normally not used in planning practice. Moreover, primarily the cities with more than 100.000 inhabitants have a public authority that is powerful and well-trained enough to use geomatics as part of the daily work. In contrast, most small towns and municipalities have only little experience in using GIS-technology. Generally there is not enough GIS data available to make landscape planning more effective, improve the planning results and to minimize the costs of planning.

But during the past few years a number of developments in the scientific field of geomatics improved the range of applications and the acceptance of GIS tools for planning purposes, such as the increasing availability of commercial geographic data, the support of field-work by the use of GPS, the use of satellite remote sensing for landscape management purposes (IRS, Quickbird 2, Ikonos 2) and the advanced webGIS technology. Additional developments minimize required investments for the technical working area of GIS (hardware and software), reduce the required technical knowledge to handle these tools and solve the problems of interoperability (GREVE 2001, SCHAAL 2004).

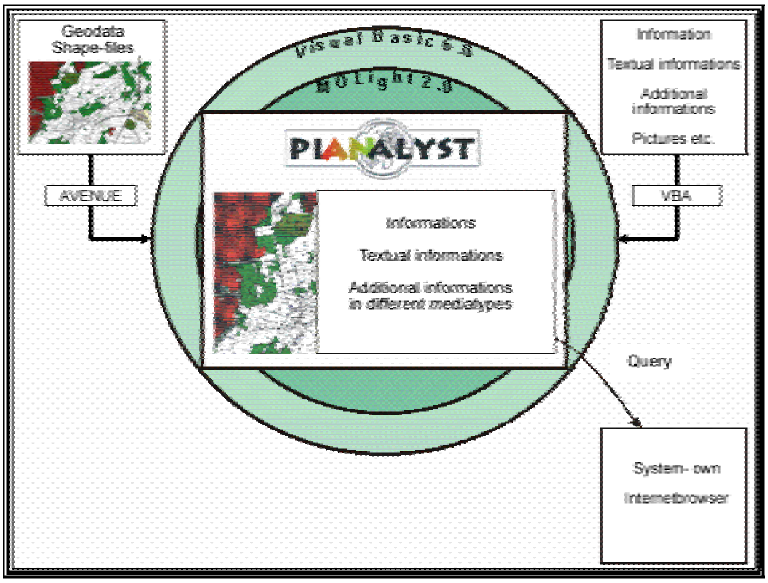
3. Exploring and Presenting Planning Information – The PLANalyst

After drawing up a landscape plan, the results, the planning information and the planning analysis should be explored and presented in an adequate form. The digital presentation of spatial plans and programmes has to take into account that planning information usually is addressed to decision makers, authorities, land users und other public persons. Presumably, none of these stakeholders will be experienced in handling Geographic Information Systems (GIS). Consequently the viewing software has to be a user-friendly application with a clearly arranged graphical user interface (GUI). Commercial GIS-viewing software (ex. ESRI®´s ArcExplorer, AutoDesk MapGuide etc.) lacks the required specific functionality to present plans and programmes and the use of the software mostly requires GIS-knowledge. Furthermore, no runtime license fees for GIS-viewing software should be charged.

The “Steinbeis Centrum of Applied GIS and Environmental Research” (STAGU) at the University of Vechta developed a viewer software for the landscape plan and the regional plan of the district Emsland, which has been published on CD (SCHAAL et al. 2003). The developed planning viewer “PLANalyst” is based on the ESRI® -Software Map-Objects LT 2.0 and Visual Basic 6.0. The conceptual framework of the PLANalyst is shown in figure 2.

The data used for the landscape plan consists of ArcView shape-files, raster data and additional factual/attribute data, stored in databases. A separate layer was created for each of the planning categories (e.g. nature protection areas, landscape protection areas, areas of the EC habitats directive etc.). The structure of the attribute-tables for all layers is identical: Each individual object of the plan has its own primary ID as a reference number for textual and factual attribute information. Additional information, such as ordinances of nature protection areas or photos as well as the description of the planning areas is converted into html-format. The required expenditure of work was reduced by the support of data conversion processes using script-languages such as VBA, Avenue etc. Using the HTML-format one can explore and display the attribute information of all the objects and the description of the plans in a standard browser, without having to install any Java/ActiveX applications or plug-ins. Furthermore the standard browser functionalities such as Search, Print, Copy and Paste can be used.

Figure 2: Conceptual Framework of the PLANalyst

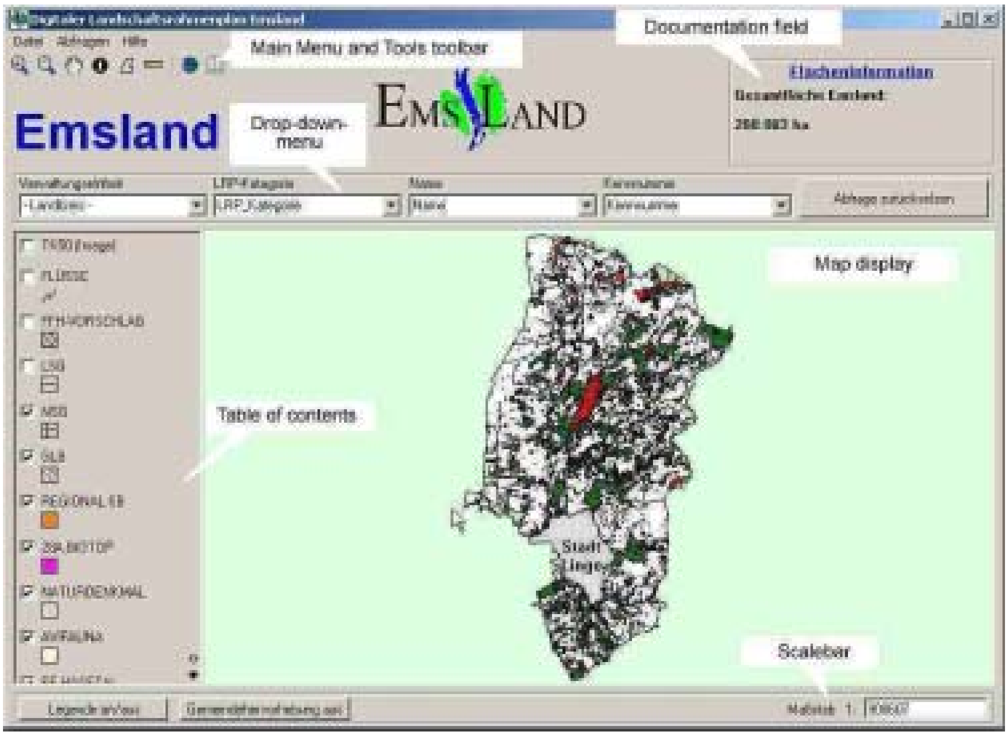


The planning viewer "PLANalyst" was developed with Visual Basic 6 and MapObjects LT 2.0. MapObjects LT 2.0 allows for the implementation of dynamic mapping and GIS functionalities in Windows applications. MapObjects is a collection of mapping and GIS components and contains ActiveX-Control (OCX) and more than thirty ActiveX-Automation objects. The distribution of the application does not entail any charges for runtime-licenses. The graphical user interface (GUI) consists of two groups of objects that interact: Windows Standard-Controlling-Objects and MapObjects LT Standard Control-Objects. The map - the main control element of MapObjects LT 2.0 – allows for the display of shape-files, ArcInfo coverages, CAD data and different raster formats. The Emsland – Landscape Plan visualisation-tool PLANalyst uses shape-files as its basis. Attribute data and further information is displayed in HTML format.

The layout of the map is based on the printed version of the landscape-plan. In contrast to the regional plan, landscape plans do not have a binding ordinance on cartographic symbology. This fact simplifies the visualization of the maps significantly, because the MapObjects LT 2.0 – symbol editor is restricted. The PLANalyst contains a number of clearly arranged useful features to explore the landscape plan. The user can activate or deactivate each layer to optimise the complexity of the map. The displayed themes of the map are documented and controlled by a table of contents on the left side of the window, which can also be switched off. To improve the spatial orientation, a topographic map is displayed at a scale larger than 1:50.000. The user can navigate through multiple map layers by using the zoom- and pan- tools. Furthermore the PLANalyst zooms and highlights a selected municipality automatically.

In the main menu, the textual information of the plan can be activated and then displayed in the Web browser (fig. 3). One can conduct dynamic spatial queries and run statistics on selected areas. Statistics can be generated to show each municipality's change in size for the different categories of protected areas. Statistics on the area of a specific object such as the landscape protection area are of special interest, if the object is located in different municipalities. Specific attribute information, such as the number of registered and possibly endangered species, ordinances of nature protection areas and photos can be displayed in a standard browser (fig.4).

Figure 3: Graphical User Interface of the Emsland Landscape PLANalyst



The planning-analysis functions include
- hierarchical queries,
- object-orientated queries,
- generating area statistics,
- user defined measuring of lengths and areas and the
- interactive exploring of factual information.

Figure 4: Specific attribute information, displayed in a standard browser

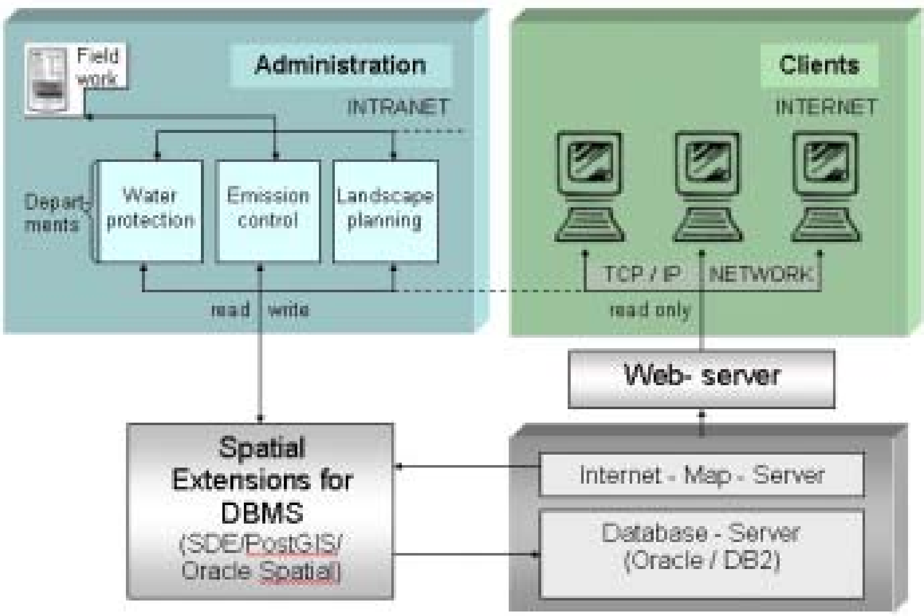
4. Further prospects: integrated data management for planning applications

Software such as the PLANalyst could improve public participation and the work of public planning authorities, if specific additional knowledge on landscape protection and landscape management are integrated in GIS-viewing tools. Independent of the fact, whether GIS information for landscape planning is distributed on CD or via internet using map server technology, landscape planning could be improved by a systematic use of geomatics. In the future, environmental planning will be based on a steadily increasing quantity of environmental data. But experience shows that the actual situation in Germany is characterized by a lack of current data and a lack of concepts to handle integrated data management (BUHMANN AND PIETSCH 1999). As a result, landscape planning is ineffective and entails unnecessary costs for drawing up landscape plans.

One has to take into account that landscape planning in Germany is based on a centralized structure of public authorities responsible, established as a regional administration, a district administration or a municipal administration. Inside these organizations the responsibilities for monitoring, protecting and planning environmental issues are divided into different departments and agencies such as water-protection, soil-protection, biodiversity, land-use planning, surveying etc. Normally each of the sections collects its own data in its own databases and data storage systems. Landscape planning however, is a cross-sectoral planning task and therefore requires cross-sectoral data.

Improving landscape planning on the informative side requires the use of integrated data management to improve the acquisition, analysis and presentation of environmental information (Bryan 2003). For such an integrated data management the data acquisition, storage and retrieval will have to be supported by a unique geographic information system in an integrated network. The working process of these public authorities have to be organized in a similar way. The concept for such an integrated environmental information management is shown in figure 5. Scalable Systems such as ESRI´s software family ArcGIS contain reasonable technical solutions for these tasks, which has been witnessed for example with the “information and administration system for nature protection Hesse” (HMULV 2004). How to implement these solutions in the work environment of mainly public authorities and how to train the staff to work with these systems seem to be the at last the greater challenge!

Figure 5: Proposed structure of an integrated landscape planning system



On the other hand, the improvement of the environmental information management could change the character of landscape planning fundamentally. The inventory and evaluation of the current status of nature and landscape as well as the environmental monitoring could be based on a dynamic information-system. The informational basis of landscape plans would get the function of an environmental monitoring instrument, which gives important indications for ecological changes. Only parts of a present landscape plan, would have to be part of political and administrative decisions: the objectives for improving the landscapes´ quality and the proposals for measures would have to be decided by politics and administration in fixed terms. Additionally the general public could gain specific current environmental information via internet and map-server-technology according to the EC directive 2003/4/EC on public access to environmental information.

5. Literature

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