

The Spatial Information Management in the Cadastre and NSDI in North-Rhine Westphalia, Germany

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1. Abstract

Geoinformation (spatial data that describe features on the Earth's surface) contributes a great deal to our cumulative understanding in modern information- and communication-oriented societies. It has become a world-wide economic commodity of ever-increasing importance. Moreover, the development, production, and processing of geoinformation and related technologies is proving to be a fertile area for the creation of new jobs.

Germany is a classic example of a country that takes great pride in its highly accurate maps and infrastructure data, both of which are a result of a long history of cadastre and exceptional surveying and mapping work. In the last three decades, due to historical and technical reasons, three independent geoinformation systems were developed in Germany in the area of cadastre and surveying and mapping. Currently, these three independent systems are being brought together, which will help to ease access to this public geodata.

Realizing that the value of geoinformation is tremendously related to the access to this data (as a basic economic good), North-Rhine Westphalia (NRW) started to set up its Geodata Infrastructure, called GDI NRW. The GDI NRW initiative is seen as crucial to the activation of the geoinformation market. It will provide solutions for technical, legal, socio-economic and institutional questions regarding an open geoinformation market.

With the new data approach on one side, together with the GDI NRW on the other, a brand new and common concept for Spatial Information Management of public data will be realized in the near future in North-Rhine Westphalia.

2. The Situation in North-Rhine Westphalia and Germany

2.1. Cadastre and Surveying and Mapping today

Germany is a classic example of a country that takes great pride in its highly accurate maps and infrastructure data, both of which are a result of a long history of cadastre and exceptional surveying and mapping work. In two steps, the German pure taxation cadastre (early 19th century) developed into a property cadastre (early 20th century) and since 1970 has developed into a multipurpose cadastre which is used today by a large variety of users. The German states are responsible for the cadastre as it relates to the 1:1000 scale.

Through the use of a unique parcel identifier, the data flow between the cadastre and the separate Land Register is realized. The Land Register, which shows the legal status of all real property, is the responsibility of the federal government and is maintained by the local courts of law. In general, the Land Register is generally not available in digital form. Together, the Land Register and the Cadastre are the basis for land management in Germany [1].

In Germany, the introduction of geoinformation systems (GIS) started in the early seventies. The cadastral information is stored in two independent systems, the Automated Real Estate Map (ALK), which handles the graphical information, and the Automated Real Estate Register (ALB), which contains the attribute data. For the land register no common GIS was developed yet.

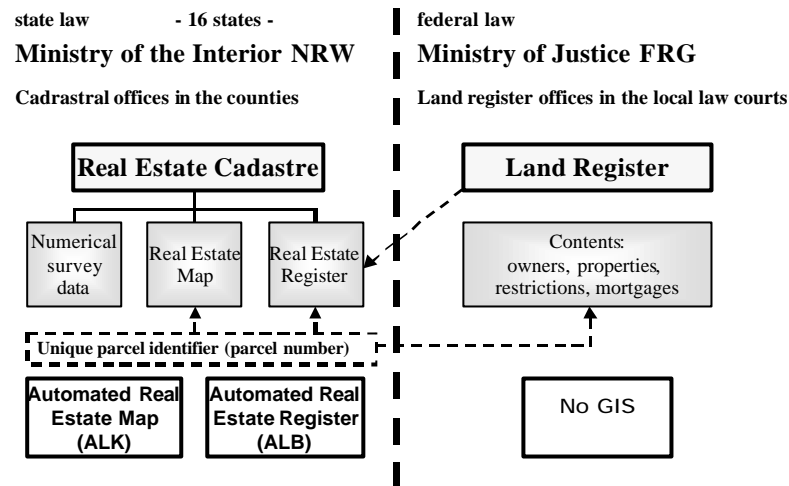


Fig.: Situation of land management in Germany

As with the cadastre, surveying and mapping products in Germany at the scales 1:25000 to 1:100000 have a very long tradition beginning with military use and then later developing into products for civil use. The Authoritative Topographic and Cartographic Information System (ATKIS) was developed during the late eighties to bring this mapping information into a GIS. ATKIS, which consists of a digital landscape model (basis DLM) with an accuracy of +/- 3 m and contains the content of the classic maps 1:25000, is available in digital format for all of Germany.

Today, the Automated Real Estate Map (ALK), the Automated Real Estate Register (ALB) and the Authoritative Topographic and Cartographic Information System (ATKIS), which were developed before powerful geoinformation systems were introduced on the market, have become increasingly insufficient. The reasons are the following:

Technical insufficiencies	logical/model insufficiencies
<ul style="list-style-type: none"> no "standard" notation of the data models no concept to integrate metadata (data quality) difficulties in realization of cartographic aspects 	<ul style="list-style-type: none"> no systematic object-related view in ALB/ALK strong differences between ALB/ALK and ATKIS no consistent data modeling between cadastre and topography

2.2. The development of Cadastre and Surveying and Mapping in the near future

Currently, the cadastral administrations of all German states are developing the Official Cadastral Information System "ALKIS" which will integrate cadastral data of the ALB and ALK. This so-called "horizontal integration" will guarantee a redundant-free data set for the cadastre. ALKIS will consequently employ the corresponding national and international norms and standards which are currently under development (e.g. ISO).

In addition, the data model of ALKIS will be identical to the updated Authoritative Topographic and Cartographic Information System (ATKIS):

Technical development	logical/model development
<ul style="list-style-type: none"> Standardized notation Integration of metadata Geometry directly addressed to objects Enable to reference other GIS-objects Enable to manage cartographic data 	<ul style="list-style-type: none"> Unique data model for ALKIS and ATKIS Integration of objects without position (geometry), e.g. owner Enable to manage historical data

Because of the unique data model for ALKIS and ATKIS and the harmonization of the object catalogues, it will be possible to use collected data on both the cadastral level and the surveying and mapping level. This "vertical integration" is the first step to the general approach that data should only be collected once and should be used for different scales. The data of ALKIS and ATKIS will serve as the publicly-available core data from which other users can utilize to fit their specific needs. The combination of core data with user-specific data allows the greatest benefit for all participants in the geodata market.

The general approach of the vertical integration of data can be attained if the task of cartographic generalization is solved. Over the next few years, research will focus on this subject. This will open the chance to reorganize Spatial Information Management - from the standpoint of the data.

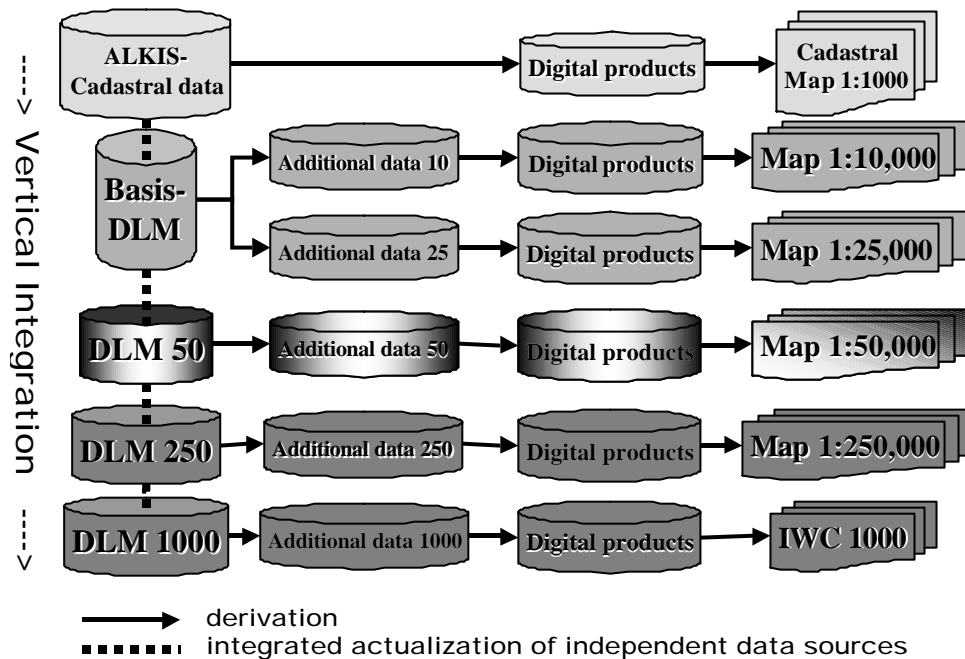


Fig.: Strategy for future data management in Germany
- vertical integration of data

2.3. The use of geoinformation in Germany

As a result of Germany's federal structure, data collection is largely decentralized and carried out mostly on the regional and local level, which means that the processing and maintenance of data is mostly tailored to local and regional requirements. This leads to built-in incompatibility in regards to both the range and freshness of the data collected and the collection criteria, periods and priorities. This, and the insufficient level of standardization of geodata, is a sufficient obstacle for the extensive and easy use of data. In fact, additional time, labor and money often has to be spent on using different data sources.

Potential data producers and users lack sufficient knowledge about the scope, quality, freshness and availability of core and user-specific geodata. If such metadata were available, duplicate surveys could be avoided and the use of data intensified. This could help to overcome redundancy and the lack of harmonization of data.

When setting prices for the transfer of geodata, there is a conflict in Germany between client-friendly, fair market prices on the one hand, and the fact that the public coffers are under pressure to recoup costs by raising refinancing capital on the other hand. In addition, cost negotiations generally need to be conducted with each individual German state in each specific case and for each different situation in compliance with ever-changing guidelines.

Generally speaking, people are often not sufficiently aware of the key role that geoinformation could play in Germany as a national resource in the fields of administration and the economy. Research shows that approximately 80 % of all decisions in the public sector are based on georeferenced data.

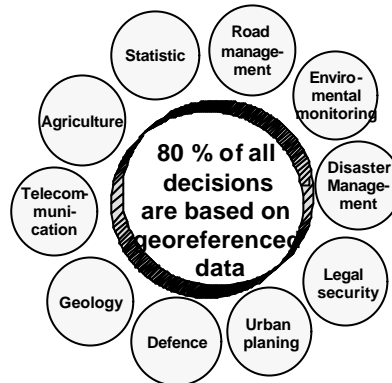


Fig.: Use and importance of geoinformation in the public sector

Therefore, the availability of available digital data is gaining more and more importance. Among the notable areas of application in the public and private sector are regional planning, telemarketing, employment, industry, traffic control, road management, environmental protection, insurance, preservation of natural heritage areas, health care, forestry and agriculture, land management, transportation, education, utilities management, as well as citizen participation in administrative decisions.

3. GEOBASIS.NRW

As mentioned before, the cadastre and, therefore, the introduction of ALKIS is under the responsibility of each individual German state. In North-Rhine Westphalia a large pilot project called GEOBASIS.NRW was started by the Ministry of the Interior in 1999. The focus of this project is a wider use of the geodata provided by ALKIS both inside and outside the communities. The project will help to improve the performance of the communities and is closely related to the setting up of the Geodata Infrastructure called GDI NRW. The goal of this GEOBASIS.NRW is the establishment of network-based GIS solutions for local communities, integrating all geodata handled by the communities, the basis of which will be the ALKIS standard. The challenge of this project is to reach interoperability between different solutions within towns and counties, because, in most cases, different geoinformation systems are installed for different applications. Therefore, a component-based architecture following the rules of OpenGIS is currently being developed.

For the realization of GEOBASIS.NRW more than 100 participants from towns and counties, GIS companies, state institutions, and public and private users are working together on five pilot scenarios. These pilot teams were established to represent the unique circumstances in NRW. Today the largest obstacle for the use of geodata is that IT systems are not formed very uniformly in NRW. Therefore, it is an ongoing process to extend participation and co-operation of GIS enterprises and users as widely as possible. This shall improve the security of investments for users and for software enterprises. On the other side, it shall enable system interoperability and usefulness of geodata for all market players. From the point of view of the state, it is the common interest of communities and of the state itself to guarantee a nation-wide conformity of the legal aspects concerning the real property register (safeguarding of property).

To focus on these goals and to guarantee synergistic effects, experts from the state administration and from the five project teams are working together on special issues:

WG ALKIS (co-ordination): This working group is responsible for the general co-ordination of the project in NRW. It accompanies the five project teams and co-ordinates the work of the other working groups. In addition it represents the state interests on the federal level.

WG Migration: The transfer of given ALB and ALK data stocks to the new cadastral standard ALKIS must proceed trouble-free, and automatically. It is the task of this working group to analyze how to develop the needed integration of ALB and ALK while considering each communities' unique situation.

WG Cadastral Organization: In North-Rhine Westphalia legal reliability concerning the real property register will be guaranteed in the future by the nation-wide ALKIS standard and the state-wide business processes. These processes are defined by the working group and will be used for the certification of the software products (GIS). Out of the cadastral agencies the business processes must fit the GIS activities of the individual communities. These processes are respectively modeled by the communities and all project teams.

WG access to data: In the German States the use of information, in this context (public) geodata, is restricted by federal laws (e.g. the law regarding data protection) and additional state laws (e.g. cadastral law). These laws regulate the use, trade and transfer of data. At present the working group, which consist of members of the Surveying and Cadastre Administration of North-Rhine Westphalia is working out suggestions regarding the alterations of the state laws concerning the survey and real property register. From a technical point of view, the citizens' access to public administration data shall be as open as possible and as secure as necessary. These alterations shall ease access to and use of property register data.

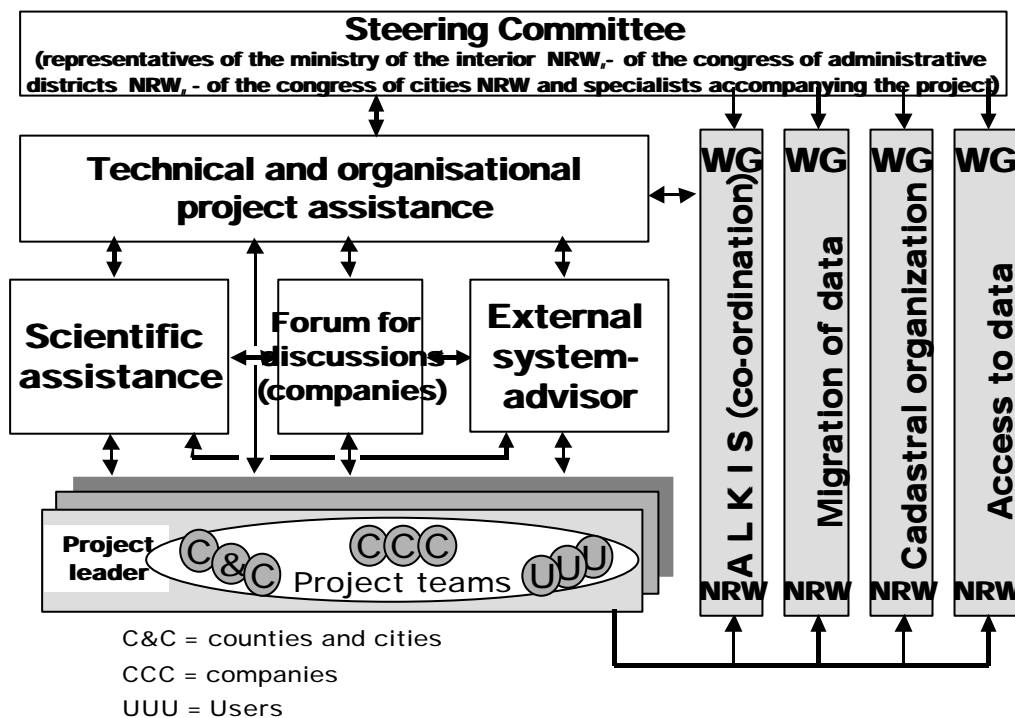


Fig.: Organization and participation in the project GEOBASIS.NRW

Currently, in the project GEOBASIS.NRW, which started in the middle of 1999, the local requests and the resultant specifications are defined. The implementation of these standards and the demonstration of the pilots is planned for 2001 and 2002.

4. Geodata Infrastructure North-Rhine Westphalia (GDI NRW)

4.1. Goals and basis of GDI NRW

Realizing geoinformation as a basic economic good, the German State North-Rhine Westphalia (NRW) has begun to set up a Geodata Infrastructure – the GDI NRW. Oriented to international examples, this project shall be based upon the relevant international norms and industrial standards. It is intended to activate and stimulate the market for geodata in NRW with the help of this initiative.

GDI NRW is integrated in the framework of the so-called Software-Initiative NRW. This initiative was started in June 1999 by the Minister President of NRW. In this context, the Software-Initiative stems from the assumption that software as an economic factor implies greater development potential for NRW. With the start of the software initiative the government of NRW is pursuing different goals [3]:

Insufficiencies today	Goals of the Software-Initiative in NRW
<ul style="list-style-type: none"> • Exact knowledge about market potential of geodata is unknown • Lack of integration of basic geodata (core data) and special geodata • Insufficient supply of user-friendly information products and geodata-services • Missing of an open network for geodata • Insufficient legal conditions regarding the access to official geodata by private users. 	<ul style="list-style-type: none"> • Dealing with the scarcity of qualified specialists. • Making the NRW software branch more transparent • Internationalizing the local software marketing • Supporting the development of innovative product ideas • Motivating enterprises to start co-operations • Accelerating the transfer of know-how

To reach these goals, the work of the Software Initiative is divided among several working groups. One of these working groups – called “Software-Solutions and their Use in different Branches of Business” – is responsible for many different projects concerning the Software-Initiative. The project to which the greatest stress is given is the aforementioned GDI NRW. The GDI NRW will contain all technical, legal, socio-economic and institutional measures that are necessary for a working, trouble-free open market of geodata. The infrastructure will be strongly characterized by international influences.

To guarantee an organized development of GDI NRW, a permanent decision-body has been appointed by the Minister President’s office. This “GI-Committee NRW” (Committee for Geoinformation in North-Rhine Westphalia) creates strategies for the creation of GDI, judges incoming project proposals referring to GDI, and gives advice to the Minister President’s office concerning all questions about geoinformation. Members of the committee are representatives from the Minister President’s office, the Ministry of the Interior NRW, the DDGI (German Umbrella Organization for Geographic Information) and the software initiative.

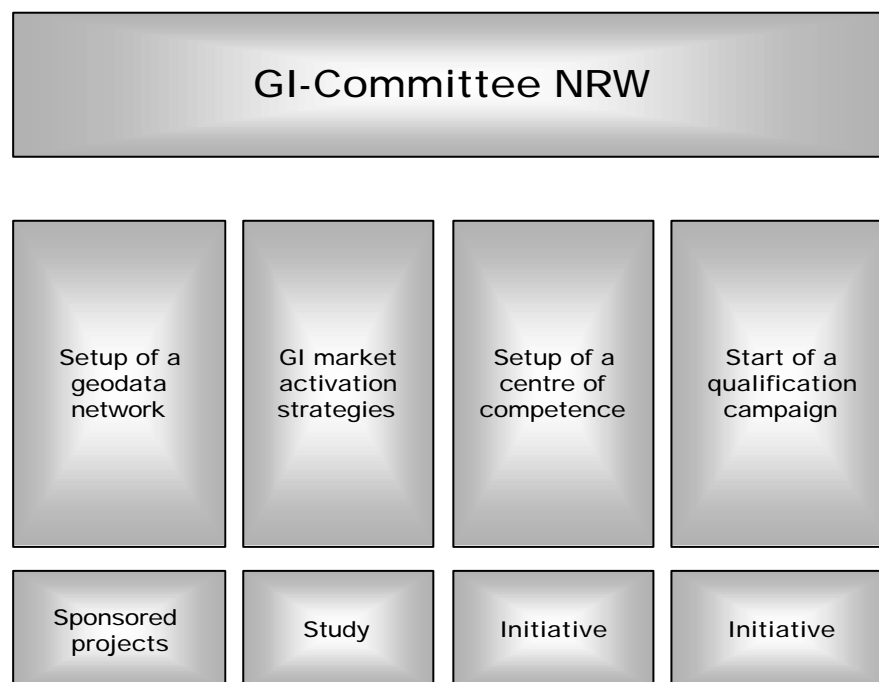


Fig.: Organizational aspects of GDI NRW

From a technical point of view, GDI NRW is based on an open geodata network, the structure of which is uniform for North-Rhine Westphalia and follows international standards. At present the necessary norms and standards for the arrangement of GDI NRW are being developed by standardization-bodies and representatives of industry. Usually norms and standards for geodata are modeled within the bounds of ISO TC 211 "Geographical Information/Geomatics" and the OpenGIS Consortium (OGC). Available results shall already be utilized at the set-up of GDI NRW.

This network allows interoperability among the different GIS and transparent access to geodata distributed over the network with the help of standard internet-services.

GDI NRW shall provide an ISO/OGC based solution for a metadata information system. The customer will access this information through a central metadata-information service. This service is offered by a neutral clearing house and gives information about all data and services supplied in the network. The metadata will provide information about available geodata regarding topicality, reliability, exactness, completeness, origin, and range of applications. Through GDI NRW customers will get answers to questions like: "Who offers what kind of geodata of a certain quality and at what costs?"

The metadata-information service shall give unbiased information to interested users and refers them to the appropriate data provider. The distribution of geodata itself is completed by the provider of the respective geodata server. The provider of the clearing house is an independent institution without bias. A call center can be assigned to the clearing house.

4.2. Other aspects / Socio-economic environment

Costs and prices: The establishment of extensive stocks of geodata that is characterized by high accuracy, reliability and topicality is very costly. Reasons include labor and high initial investment costs. The majority of this work is traditionally undertaken by the state and the communities. Because the data deals with public services, the collection of the data is financed by taxes. Disputes over prices and fees for these services may arise over the following questions:

- Does the state act in sense of precaution for existence?
- Is the state forced to finance these services completely by fees?
- Is the state subjected to the rules of market economy?
- Does the state arrange the prices following supply and demand?
- Are the prices fixed by other criterions?

Competence, qualification: The impetuous development in the field of geoinformation during the last years has led to a perceptible lack of specialists. This shortage of qualified workers applies to academic as well as non-academic jobs. Education in relevant conventional job fields like geodesy, geography and cartography slowly adapt to these new challenges. The new subject "Geoinformation Science", which has been emerging for the last few years, is already attracting more and more students. But the current need of specialists can only be adequately filled through further and extensive education measures.

Support of small and medium enterprises (SME): Consideration should be taken to support young, innovative companies within the data market. This support will promote the innovation cycles in the field of geoinformation. In addition, these companies must be very well prepared for international competition.

5. Conclusion

Also within public administration, the role of geoinformation is changing. Approximately 80% of all activities and decisions in this field are based on geoinformation. Many departments within community administrations and state authorities already are equipped with geoinformation systems. They complement the core data of the Surveying and Cadastral Administration with their own user-specific geodata and use them for spatial planning and analyses. In the near future, the integration of local and state GIS with integrated interdisciplinary business processes shall be attained. In this context, the systems will be accessibly to all external interested parties within the legal framework.

It can be expected that profitable state services will be increasingly called into question by the private sector. Here the opinion predominates that private enterprises could as well meet the demands; that they even could act more efficiently and flexibly on the market. For this reason models have to be developed that make a partnership-like coexistence of public and private institutions possible without socializing the costs and transferring the profits into private ownership.

To meet this development, North-Rhine Westphalia is currently planning a geodata infrastructure (GDI NRW). GDI NRW will focus on solutions regarding the liberalization of access to publicly held data, the secure transfer of data via the Internet and other legal conditions regarding the transfer and usage of geodata in an open network environment. Further socio-economic aspects like costs and prices, e-commerce solutions and questions of competence and qualification have to be considered. Institutional considerations include the assignment of the parts of the different market actors within value adding chains, co-operative research and development, and contribution to the international market.

GDI NRW, together with GEOBASIS.NRW, which focuses on the core data of cadastre and surveying and mapping, will open the chance to reorganize the Spatial Information Management in North-Rhine Westphalia.

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