DEVELOPMENT IN THE GERMAN CADASTRE

Desenvolvimento do Cadastron na Alemanha

GRISCHA GUNDELSWEILER[1]
THOMAS BARTOSCHEK[1]
LUCILENE ANTUNES CORREIA MARQUES DE SÁ[2]

[1]Institute for Geoinformatics, University of Münster
Robert-Koch-Str. 26-28, 48149 Münster, Germany
{gundelsw, bartoschek}@uni-muenster.de
[2]Universidade Federal de Pernambuco – UFPE
Departamento de Engenharia Cartográfica – DECart
Programa de Pós-graduação em Ciências Geodésicas e Tecnologias da Geoinformação – PPGCGTG
Av. Acad. Hélio Ramos, s/n – 50740-530 Recife, Pernambuco, Brasil
lacms@ufpe.br

ABSTRACT

The first part of the paper will give an overview on the classification of ALKIS within the German NSDI initiative. The following two parts describe the ALKIS-Model and the implementation of the system in the case of North Rhine-Westphalia. The penultimate point focuses upon the discussion of an increasing use and value of (official) geographical data. In a final step, future prospects are presented.
Keywords: German Cadastre; AAA-Reference Model; Standardization.

RESUMO

A primeira parte do artigo traz uma visão geral do sistema ALKIS - Amtliches Liegenschaftskataster Informationssystem, que é uma iniciativa do Governo Alemão dentro do NSDI - National Spatial Data Infrastructure. As duas partes seguintes descrevem o modelo ALKIS e a implantação do sistema em uma região piloto, a de Rhine-Westphalia Norte. No penúltimo item é formulada uma discussão sobre a utilização e o crescente valor dos dados espaciais. Na etapa do final é feita uma apresentação sobre o futuro do sistema.
Palavras-Chave: Cadastro Alemão; Modelo de Referência AAA; Padronização.

1. INTRODUCTION

Germany's development of a NSDI - National Spatial Data Infrastructure commenced in the early 1970s (Grünreich, 2000). Right now a redesign of the German digital cadastral information system ALK – which has been in use for approximately one decade – is under development and a new model called ALKIS® (Official Cadastral Information System) has been launched (Seifert, 2006).

The Cadastre as a land information system is very important for social and economic development and therefore it is crucial that governments invest in appropriate cadastral system development (FIG, 1995). To manage the general demand for appropriately produced digital geodata a sustainable concept has been developed that integrates not only the cadastral data, but also all datasets that are offered by the surveying departments.

The Federal Governments in Germany together with the surveying institutes in the 16 states are working on a NSDI (named: *Geodateninfrastruktur Deutschland* – GDI-DE®). The cadastral data and the topographical data sets of the surveying authorities are identified as basic elements in the German SDI (Hawerk, 2002). With the AAA-Reference Model a fundamental technical and practical contribution for the GDI-DE is available now (Seifert, 2006).

2. THE AAA-REFERENCE MODEL (AFIS®-ALKIS®-ATKIS®)

The AAA (AFIS®-ALKIS®-ATKIS®) - Model includes the following three components:

- AFIS® (Official geodetic points information system)
- ALKIS® (Official Cadastral Information System)
- ATKIS® (Authoritative Topographic-Cartographic Information System)

AFIS® contains information about the geodetic points and their spatial reference. Reference points for location, height, gravity and reference stations for GPS (Satellite Positioning Service of the German National Survey – SAPOS®) are integrated. **ALKIS®** shall harmonize the structures of the existing digital cadastral maps and the topographic database ATKIS and integrate the cadastral map and the digital cadastral register into one single model which was usually separated for historical and technical reasons. It was the first cadastral data base completely designed under ISO standards (Hawerk, 2002). **ATKIS®** has been developed to establish and maintain uniform topographic geodata bases at the federal level. In addition to the traditional topographic map series of the states (*Länder*) of the Federal Republic this project aims at the provision of digital models of the earth´s surface suited for data processing. ATKIS can also be used as a base of spatial reference and for the linkage to and combination with thematic geodata (Grünreich, 2000).

The AAA-Reference Model for the basic geodata sets of all public surveying and mapping authorities in Germany has been developed by the Working

Committee of the Surveying Authorities of the States of the Federal Republic of Germany (AdV). AAA is described in the "Documentation on the Modelling of Geoinformation of Official Surveying and mapping in Germany (GeoInfoDok)", which is published on www.advonline.de (Seifert, 2006). The OGC – Specifications as well as the ISO-Standards (19100 series) in the field of Geographic Information are the basis for the AAA-Model (Hawerk, 2002). The UML - Unified Modeling Language serves as the modelling language for describing the application scheme and the feature catalogue. This enables a consistent maintenance and enhancement of the schemeta (Köster and Müller, 2005).

The advantages of AAA-modelling are the integration of the Spatial Reference System, the Real Estate Cadastre and Topography in one AAA-application scheme, the harmonisation of cadastral and topographic data and the AAA basic scheme as base for the modelling of application-specific thematic (Seifert, 2006).

Besides the already addressed models for official basic geodata sets, the AAA-Model also integrates the data management of historical data, the definition of metadata and a Standard-Based Data Exchange Interface (NAS), which is based on Geography Markup Language - GML3 (Köster and Müller, 2005).

With the AAA-Reference Model the foundations for a broadly applicable geodata basis have been laid. This can be the impulse for the implementation of a beneficial and also economically successful SDI (Köster and Müller, 2005).

3. ALKIS – GERMANY'S CADASTRAL INFORMATION SYSTEM

The Land registration system in Germany is a duplex system. The legal situation of each parcel is described in the land register called "Grundbuch". The geometric description of all boundaries in the Automated Cadastral Map (ALK), field records and textual records in the Automated Property Register (ALB) are in the hands of the cadastral authorities. Only Grundbuch and cadastre in combination give a complete overview about legal and *de facto* land tenure. Both registers must be constantly updated and kept in correspondence with each other (Hawerk, 2002).

The roots of the ALB and ALK systems date back to the 70s and 80s of the last century. Further development of these software systems seemed not to offer future oriented solutions. Therefore, AdV decided to design a new and future oriented system ALKIS® in combination with a re-design of the Official Topographic and Cartographic Information System ATKIS (Hawerk, 2001).

ALKIS® in combination with ATKIS® is designed to:

- Process all necessary cadastral and topographical data for a parcel based map and register of land owners, land use and more unified basic data for the entire Republic,
- Control the use and maintenance of the system and to

- Enable the use of the entire geographical data of the surveying authorities for all users via a metadata system including quality information for all data and a standardised data interface for ALKIS® and ATKIS®.

Of course already established links of the users' specific data to ALK, ALB or ATKIS® still have to be possible in the new systems without reasonable new investments on their side. They shall trust in the sustainability of their investment in data. (Hawerk, 2002).

This new standard will help to meet some of the major past obstacles, nation wide provision of standardised cadastral data (Hawerk, 2004).

3.1 – ISO - Standards in ALKIS

ALKIS® is the first cadastral data base completely designed under ISO standards (Hawerk, 2004). This new approach was set up in order to harmonize the structures of the existing digital cadastral maps and the topographic database ATKIS® is to integrate the cadastral map and the digital cadastral register into a single concept (Hawerk, 2004).

This conceptual data model is completely object based and describes geographic and nongeographic features as well as their relations (associations). In order to describe this model in a standardized way it has been based on the ISO draft standards in the field of geographic information (Hawerk, 2004). Most states in Germany are on track to establish this new system during the next years. The GIS industry is now carrying out the software solutions. The front ends will use browser technology for the access to the system. This is one of the important factors to make cadastre fit for e-government and SDI (Hawerk, 2004).

Therefore the approaches aiming at GIS interoperability like the ones which are coming up from the concepts of ISO and from the OGC (Open GIS Consortium) are very interesting in this field and have to be taken into account by modelling the new application scheme ALKIS® (Seifert, 2002).

ISO has formulated some objectives that are also valid for ALKIS®:

- Increase the understanding and usage of geographic information.
- Increase the availability, access, integration, and sharing of geographic information.
- Promote the efficient, effective, and economic use of digital geographic information and associated hardware and software systems.
- Contribute to a unified approach to addressing global ecological and humanitarian problems.

The AdV has adopted these aims and decided to take into account the ISO standards within the new application scheme ALKIS® as far as possible (Seifert, 2002)

ALKIS® applies a lot of ISO standards which are generally issued as Draft International Standards (DIS). In detail the conceptual application scheme ALKIS® is based on the specifications for Reference model, conceptual scheme language,

Conformance and testing Spatial scheme, Temporal scheme, Rules for application scheme, Feature cataloguing methodology, Quality principles, Metadata and Encoding. All of them are combined in the ISO category of Geographic information.

3.2 – Methodology for Feature Catalogue

The ALKIS® application scheme is based on real world phenomena which can be called features.

The main characteristics of features defined in ALKIS® are:

- They have a unique identifier.
- They belong to a class of features.
- They have - semantic and other - properties (attributes), especially quality information has to be mentioned here. These properties also have codes and definitions.
- They are spatially referenced or not (geographic or non-geographic features).
- Spatial objects have a spatial reference (2D or 3D-coordinates).
- Spatial objects are based optionally on a geometrical sub scheme or a topological sub scheme.
- Features are simple (atomic) or compound.
- Relations and associations between features have to be maintained.
- Features have a life cycle (they appear and disappear), for some features or even the relations the history has to be documented.

The UML is modelling language for describing the application scheme and the feature catalogue. Figure 1 shows an extract of the feature catalogue structure derived from ISO. The classes at the top were defined by ISO. But not all requirements needed in ALKIS® are provided by this standard (e.g. requirements for data consistency).

In Figure 1 the highlighted classes below contain additional feature specifications that are needed in ALKIS®. These specifications were defined as an extension within the application scheme ALKIS® (Seifert, 2002).

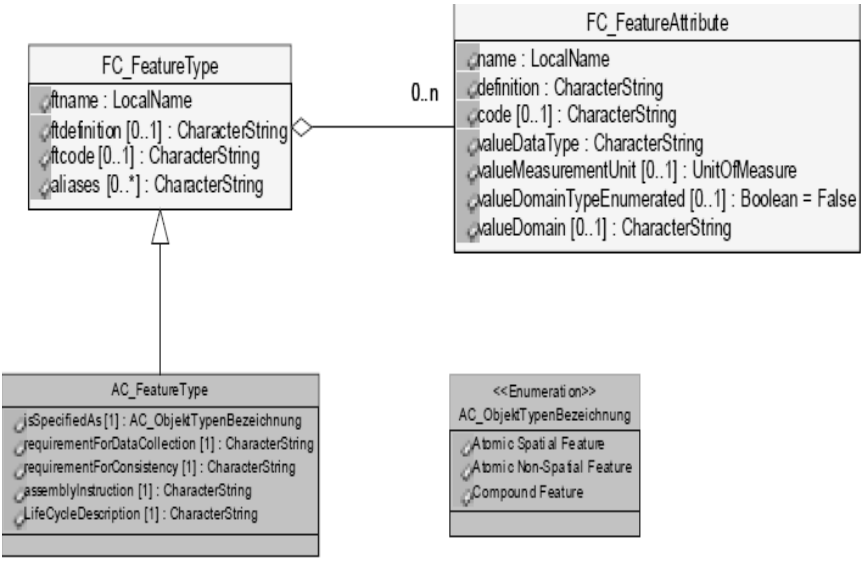
The ALKIS® application scheme is completely described by using the conceptual scheme language UML (Unified Modelling Language). In addition the feature catalogue can be converted from the UML data model into RTF or HTML data formats automatically. So users are able to read the specification without buying an expensive UML tool.

The public geospatial data in the field of cadastre is already widely used. By integration of various datasets in ALKIS®, still managed with several systems at present as mentioned before, the use and further processing of the public geospatial data will be simplified substantially. The main reason is the consistent application

of the ISO standards in the field of geographic information. So some essential advantages will arise for the users by the new conception:

- The implementation of the concept under consideration of international standards will ensure investment safeguarding, vendor independence and standardization of public geospatial data.
- Definition of a universal, browser readable interface (XML encoding) for all public geospatial data.
- ALKIS® becomes a core dataset that can easily be combined with other data from various administrations in order to build up a spatial data infrastructure in Germany.

Figure 1 – ALKIS® Feature Catalogue Structure - Seifert (2002).



Therefore ALKIS® will standardize the cadastral datasets in various ways in Germany. For the actual realization of ALKIS® some further efforts are still necessary. Besides the implementation especially the migration of the datasets requires considerable efforts.

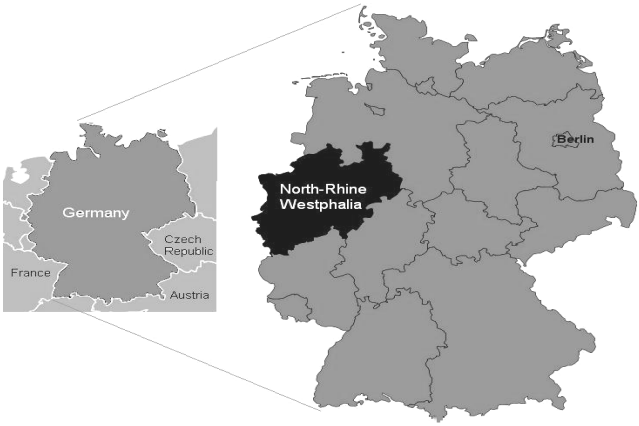
The application scheme ALKIS® has proved that ISO geographic information standards can largely be used without problems. If the GIS vendors will finally implement these standards as well, the objectives formulated by ISO, which were mentioned above, will soon become reality (Seifert, 2002).

4. IMPLEMENTATION OF ALKIS® IN NORTH RHINE-WESTPHALIA

The cadastre and, therefore, the introduction of ALKIS® are under the responsibility of each individual German state. Realising geographic information as a basic economic asset, the German State North-Rhine Westphalia started a large pilot project called GEOBASIS.NRW in 1999. The Figure 2 presents the map of localization of the study area. 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 Geo-Data Infrastructure called GDI NRW (Brüggemann, 2004). The initiative is seen as crucial to the activation of the geographical information market (Brüggemann, 2000).

The goal of 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 geographic information systems are installed for different applications. Therefore, a component-based architecture following the rules of OpenGIS has been developed.

Figure 2 – Map of the NRW



About 100 participating cities, counties, GI companies, NRW State offices, scientific and research institutes and users are co-operating in 5 project teams and have already realized prototype solutions in 7 pilot cities and counties. These pilot teams were established to represent the unique circumstances in NRW. Today the largest obstacle for the use of geodata is that Information Technology 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 geo-data for all market protagonists. From the State point of view, 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).

For all cities and counties in NRW, ALKIS® will be the basis for network integrated, interoperable local geographic information systems. Currently, the migration process from the existing solutions of ALB (digital parcel register) and ALK (digital cadastre map) is being prepared.

In parallel, the existing standard ATKIS® (Authoritative Topographic Cartographic Information System) has been changed in order to get harmonized familiar surveying and mapping standards, common to all system developments in surveying and mapping. ALKIS® and ATKIS® are conceptually integrated with AFIS®, the new German control point information system.

The scenario of IT systems in North-Rhine Westphalia is not formed very uniformly. Therefore it is absolutely necessary to extend participation and co-operation of North-Rhine Westphalian GIS enterprises as widely as possible, to guarantee system overlapping applicability and usefulness of basic geographic data and geographic data within and outside of administration (for instance of environmental administration or energy supply companies).

The common interest of communities, data users and of the state North-Rhine Westphalia rests on two aspects:

- Nearly nation-wide conformity of legal aspects concerning the real property registers (safeguarding of property)
- Standardised availability within Germany of communal basic geographic data and geodata as an economic good for varied spatial applications.

That is why the communal top associations and the survey administration of North-Rhine Westphalia at present are supporting the German project ALKIS®. ALKIS® answers all conditions demanded by open communal geographic information systems accessible to every legitimately interested person. It represents the underlying official standard for GEOBASIS.NRW. To guarantee for software enterprises investments safety and for users a basis of reliable data communication, it will consequently employ the corresponding national and international norms and standards. The ALKIS® concept is open for the connection with more GIS applications (Brüggemann, 2000).

5. THE POTENTIAL OF THE OFFICIAL CADASTRAL DATABASES AND SERVICES

The official cadastral data has been separated into parts and has been available through ALKIS® since 2005. It can be the foundation for a multiplicity of

applications and value chains if a technical and uncomplicated legal access is guaranteed. Important criteria to argue for official geodata are (Köster and Müller, 2005):

- area-wide availability
- up-to-dateness
- high quality standards

Besides the use of the data in different state departments for planning projects, taxation etc., the cadastral data has also relevance in other branches and is required by the:

- real estate industry
- insurance industry
- facility management
- utility industry
- geomarketing
- etc..

An important point is the use of the data in applications like 3D-city models (Gruenbeck, 2004). Besides data about vegetation, infrastructure and waterbodies, the part that is essential is the buildings. To allow an easy conversion of the cadastral data into a 3D city model, the data should be provided in a standardized and digital form. An example for an application is the 3DSP (http://3dsp.uni-muenster.de/publications.html) which has been developed at the University of Müster.

5.1 – Future Prospects

With the AAA-Reference Model the foundations for a provision of homogeneous digital cadastral and other official geographical data have been established. A problem is that the users' expectations towards the use of geographical data and services haven´t been sufficiently taken into account (Köster and Müller, 2005). Easy and understandable licences (for rights of use); a clear and comprehensible accounting settlement system, easy access, up-to-date data and affordable prices are the next steps that have to be taken in order for a broader, and thereby cost-efficient strategy, for usage.

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