The Role of the Cadastre in Spatial Data Infrastructure in Denmark

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Key words: Spatial data infrastructure, land administration, service-oriented architecture, role of cadastre, registration and updating of restrictions pertaining to public law, e-government

SUMMARY

In recent years, Spatial Data Infrastructure has been used in many connections. This infrastructure is to cover the need for basic spatial data, i.e. the spatial data that is used widely and transversely and that works as a basis for registration of other data.

There is no doubt that from an overall point of view the cadastre is part of the national Spatial Data Infrastructure, but which overall challenges does this give for the cadastral systems?

In Denmark, we are working with a model where the Spatial Data Infrastructure is built up through transverse cooperation in e.g. the Spatial Data Service Community. Across central and municipal authorities, solutions are being found that would have required organisational changes a few years ago. The cadastral system, the title registration system and the land-use planning system in Denmark will be redesigned over the next couple of years. The goal is for future systems to support the Spatial Data Infrastructure in Denmark. This requires that both legislation and technical solutions be coordinated across ministries and this will place great demands on the cadastral systems.

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1. INTRODUCTION

Like in other countries, the cadastral data in Denmark are digital. The Danish cadastral register has been digital since 1986, and the digital cadastral map has covered all of Denmark since 1997.

The purpose of this digitalisation was to increase efficiency and the quality of the cadastral system, and to make the use of cadastral information more widespread. The assumption was that, by means of GIS, it would be possible to use the cadastral data in a wide range of contexts within environment, agriculture, land-use planning, etc. Combining cadastral data with other data creates great value, but the cadastre is also very useful as a registration basis for information linked to properties. In short, the goal was to make the cadastre a multifunctional cadastre.

The objective of digitalisation of the cadastre has actually been reached, but society's needs have changed. Today, Denmark, as well as other countries, needs a Spatial Data Infrastructure as the basis for e-government. Cadastral data form a natural part of the Spatial Data Infrastructure, but we are facing new organisational, legal and technical challenges if the cadastre is to take up its role in the future Spatial Data Infrastructure.

In future, full e-government is to be developed for the cadastral processes, i.e. government completely without paper. It is equally important for the cadastre to be able to support the overall e-government, both privately and publicly. Based on the situation in Denmark, this paper focuses on the overall requirements the cadastre is expected to have to meet in order to support the future Danish Spatial Data Infrastructure.

2. THE DANISH CADASTRAL SYSTEM

Private licensed surveyors have the exclusive right to carry out cadastral tasks in Denmark. Cadastral changes are subject to approval by the central cadastral authority, the National Survey and Cadastre. This section provides a summary of the cadastral system in Denmark as a background to the rest of the paper.

The land registration system in Denmark was established in the 19th century as follows:

- the cadastral register identifies real properties - which might include more than one land parcel - by cadastral number(s) and area,
- the cadastral map shows all land parcels graphically,
- legal survey measurements are used to precisely identify all new parcel boundaries determined by cadastral surveys such as subdivision etc., and

- the Land Registry identifies the legal rights based on the cadastral identification.

When land is to be subdivided or property boundaries changed, both private and public landowners must apply by law to a private licensed surveyor for the necessary legal surveys and for the preparation of documents needed for submission of an application to the National Survey and Cadastre for updating the cadastre. The application must contain a copy of the cadastral map showing the alteration of the boundaries, measurement sheets showing the new boundaries, documentation for legal rights, as well as documentation showing the approval of the future land use according to land-use planning regulations and land use laws.

The approval from the National Survey and Cadastre, showing the updated cadastral register and the updated cadastral map, is returned to the licensed surveyor. Simultaneously, the approval is forwarded to the municipality, the tax authority, and to the local Land Registry so these authorities have updated cadastral information for their property management. The process of the cadastral work is controlled by the Subdivision and Land Registration Act, which provides detailed regulations. (Enemark 2002)

3. THE CADASTRE AS A BASIS FOR REGISTRATION

Over time, the Danish cadastre has changed from being primarily a basis for land valuation to a legal cadastre supporting an efficient land market as well as effective land use administration.

In practice, this has been demonstrated by a number of restrictions pertaining to public law becoming registered in the cadastral register and on the cadastral map. Restrictions pertaining to public law, such as agricultural land designated for continued agriculture purposes and forest conservation areas have been registered in the cadastre for many years. In recent years, the number of restrictions pertaining to public law in the cadastre has been expanded, so that the cadastre includes the following:

- coastal zoning – registration of seashores and dunes according to the Act of Nature Conservation
- windfall – financial aid for rebuilding forests after windfall
- soil contamination – registration of soil contaminated areas

In accordance with regulations, these restrictions pertaining to public law are updated in connection with cadastral changes. The private licensed surveyors are required to obtain information from the competent authorities and submit this information to the National Survey and Cadastre along with the cadastral application. On this basis, the National Survey and Cadastre can update the restrictions at the same time as the cadastral changes. In this way, we ensure that this information is always up-to-date in relation to the current property situation.

However, it is probably not appropriate or practicable for all restrictions pertaining to public law registered on the basis of the cadastre to be part of the cadastre or, for that matter, to be

maintained by the National Survey and Cadastre. Thus, it has been decided that easements (servitutes), which are part of the Land Registry, must be geo-referred on the cadastral map from 2008 when paperless land registration will be introduced in Denmark. It has also been decided that a new national land-use plan register is to be established in which the land-use plan boundaries are to be determined in relation to the cadastral map. It is a requirement for both registrations that:

- they must be registered in relation to the current property situation
- they are kept up to date in an effective manner in connection with cadastral changes, and
- service-based system integration can be established so that information can be immediately compared and used with other spatial data.

In short, the restrictions are to become part of the Spatial Data Infrastructure.

4. SPATIAL DATA INFRASTRUCTURE

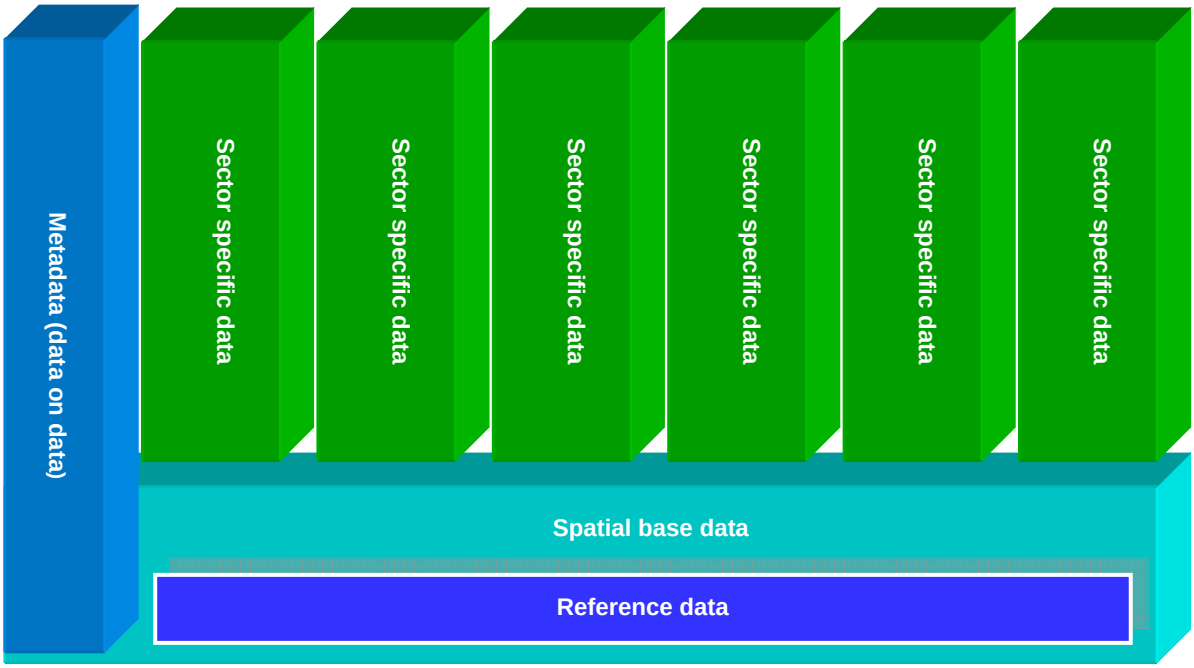
In recent years, Spatial Data Infrastructure has been used in many connections. This infrastructure is to cover the need for basic spatial data, i.e. the spatial data that is used widely and transversely and that works as a basis for registration of other data.

There is no doubt that from an overall point of view the cadastre is part of the national Spatial Data Infrastructure, but which overall challenges does this give for the cadastral systems?

According to the proposed EU Directive establishing an infrastructure for spatial information in the Community (INSPIRE), the requirements for a Spatial Data Infrastructure include: metadata, spatial data sets and spatial data services; network services and technologies; agreements on sharing, access and use; and coordination and monitoring mechanisms, processes and procedures.

In Denmark, cooperation across public authorities called the Spatial Data Service Community has been established (see http://www.xyz-geodata.dk/English/introduction.htm for English introduction). The Service Community is working on establishing a framework for the future Spatial Data Infrastructure in Denmark. In this connection, the Spatial Data Infrastructure was illustrated in this way:

Conceptual illustration of spatial data infrastructure



Spatial infrastructure concept. Today, it is possible to create a common Spatial Data Infrastructure based on standardised base data and with uniform relations to sector-specific data. Base data constitute the common foundation for the sector-specific data. Metadata are next to them with standardised information about which data are available. The rationale is that it is generally easier and cheaper for all to collectively gather and maintain base data in a coordinated and cohesive manner - because duplication of effort will be avoided, and higher quality will be obtained. (SDSC, 2004)

Spatial base data is data that is required as a **necessary component** in significant business processes or activities within several sectors (~ "multi sector data")

Reference data is base data that meets at least one of the three functional requirements:

- it is used as an **unambiguous spatial reference** of the users' data
- it is used as a **common link** between data from different sources, sectors or communities
- it provides a common **spatial context** that enables a third part to understand the information presented.

Figure 1: Conceptual illustration of spatial data infrastructure (Hulegaard, 2004)

The future Spatial Data Infrastructure is characterised by the fact that not only data will be shared via the Internet, but also functionality. The establishment of systems based on a service-oriented IT architecture (SOA) will provide the technological possibilities of doing this in practice.

Thus, a Spatial Data Infrastructure is much more than just spatial data sets. The Danish cadastral system is well on the way to living up to the majority of the above requirements. The data is digital, well described (metadata) and available through various services.

Procedures and processes for updates of the cadastre are well described. Finally, rules and principles for payment for use of data have been set up.

However, it should be expected that building a Spatial Data Infrastructure will lead to requirements for increased standardisation of data models, IT architecture and technology as well as functionality requirements for the services offered. For example, it is obvious that it should not only be possible to select a single property, but it should be possible to select several properties based on different search criteria, so that this functionality will not have to be developed in many different systems.

5. THE CADASTRE AS A BASIS FOR REGISTRATION IN THE SPATIAL DATA INFRASTRUCTURE

However, the big challenge lies in the interplay with other spatial data, where the cadastre, as base data, is the natural registration basis for information linked to properties, and where there is a need to update restrictions pertaining to public law when there are changes in the property boundaries. Updates to the restrictions pertaining to public law must be carried out immediately after the alteration of the property boundaries in order to ensure that the registration is carried out on the basis of the present property situation.

As mentioned, the cadastre today forms the basis for a number of restrictions pertaining to public law, where the National Survey and Cadastre has the legal and technical competence to update such restrictions in connection with cadastral changes. This is not the case for easements (servitutes) as well as land-use plan boundaries, which are to be registered on the basis of the cadastre from 2008 onwards, see above. The question is how we can establish solutions that are future-proof?

The update of the restrictions pertaining to public law must be effected in immediate connection with changes to the cadastre, so that it always appears which properties are affected by the registrations in question. This means that the restrictions must be updated in connection with actual legal property changes effected through the private licensed surveyors, but also in connection with technical changes to the cadastre where the National Survey and Cadastre merely improves the cadastral map without making any legal property changes[1].

The competent authorities are responsible for their own public-law registrations on the basis of information from the National Survey and Cadastre. It involves major challenges to ensure both legal and technical cohesion so that the restrictions pertaining to public law can be

[1] There is a need to improve the accuracy of the digital cadastral map in order to make the map more useful to the end users. The problem in this regard relates to the tension between the relative and absolute accuracy of property boundaries. Where the cadastral process traditionally focused on the relative accuracy between parcel boundaries, today some users, particularly local authorities and utilities, focus on absolute accuracy in order to fully combine cadastral and topographic datasets. The National Survey and Cadastre is preparing several activities in order to improve the accuracy of the digital cadastral map. (Enemark, 2002)

updated without unnecessary casework for the relevant authorities, which would prevent the desired timing for the updates.

In connection with land-use plan boundaries as well as easements (servitutes), solutions are being considered where the private licensed surveyors are required to obtain advance approval from the relevant authorities before the case is submitted to the National Survey and Cadastre for approval. The private licensed surveyors will be required to establish the necessary change data so that easements (servitutes) and land-use plan boundaries can be updated automatically, or almost automatically, when the cadastral change has been approved and registered in the cadastre. When the National Survey and Cadastre has registered the change in the cadastre, a notification will be sent to the authorities responsible for the Land Registry and the land-use planning system with information about the changes to the cadastre and the derived changes to boundaries of easements (servitutes) or land-use plans. Subsequently, the authorities can effect the update in the Land Registry and the land-use plan system, respectively.

Neither the legal nor the technical solutions have been fully developed yet. The legal aspect requires that legislation across ministries be coordinated, and that the necessary framework for the complex technical solutions be created. The technical solutions must be able to handle complicated technical challenges, such as reconciliation of data models, which will allow cohesion with the cadastral boundaries in the cadastral map. They must also be able to cope with the technological challenges of integrating complex national IT systems.

6. CONCLUSION

The cadastre is a natural part of the future Spatial Data Infrastructure. This means that, in future, there will be new requirements for standardisation of data models, technology and functionality, as well as derived organisational and legal challenges. Society needs the cadastre to be developed as an integrated part of the Spatial Data Infrastructure. It is up to the cadastral systems to fulfil this role.

As part of the future Spatial Data Infrastructure, the cadastral system must be able to function as a basis for registration of restrictions pertaining to public law that are to be registered on the basis of the property situation. This poses requirements for legal cohesion across different legislative complexes and with technical solutions across complex IT systems. Last, but not least, there will be new requirements for inter-organisational cooperation.

In Denmark, we are developing a new cadastral system, a new land registration system and a new land-use planning system. As a basis for this redesigning work, a major review of the legislative basis for the systems is being carried out to ensure that legislation as well as systems support the needs of the future. In the preliminary work, overall system requirements have been that double registration and double work must be avoided. In practice, this means that the systems must share data and functionality. The systems must appear as a single entity to citizens as well as professional players. System development is in progress. In parallel with

this, work is being done to establish the necessary regulation and agreement basis to be able to carry out the intentions in practice.

In Denmark, we are working with a model where the Spatial Data Infrastructure is built up through transverse cooperation in e.g. the Spatial Data Service Community. Across central and municipal authorities, solutions are being found that would have required organisational changes a few years ago. The changes to the land registration system, the land-use planning system and the cadastral system mean that both legislation and technical solutions must be coordinated across ministries. In the next couple of years, we will see if this proves successful!

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BIOGRAPHICAL NOTES

Background Søren Reeberg Nielsen

- M. Sc. in geodesy, cadastral science and planning, University of Aalborg, Denmark
- Member of the Danish Association of Chartered Surveyors

Brief career history:

2004 –	Deputy Director General and Head of Cadastre, National Survey and Cadastre, Denmark
2002 – 2004	Head of Cadastre, National Survey and Cadastre, Denmark
1998 – 2002	Head of Cartographic Department, National Survey and Cadastre, Denmark
1995 – 1998	Application Manager for Mapping and Utility, Intergraph Denmark Responsibilities: Support of mapping and utility products, Value added services, Help-desk and Project management
1991 – 1995	Application Engineer for Mapping and Utility, Intergraph

	Denmark Responsibilities: Consultancy and Project management
1990 – 1991	Chartered land surveyor in a private survey companies Responsibilities: Cadastral survey and land survey
1984 - 1990	Land surveyor and IT-specialist, National Cadastre, Denmark Responsibilities: Developing a system to handle digital cadastral map

Background Søren Fauerholm Christensen

- M. Sc. in geodesy, cadastral science and planning, University of Aalborg, Denmark
- Licensed to conduct cadastral surveys in Denmark
- Licensed to conduct cadastral surveys in Namibia
- Member of the Danish Association of Chartered Surveyors and appointed member of FIG Commission 7

Brief career history:

2006 –	Head of Department of Cadastre and Legal Service, National Survey and Cadastre, Denmark
2005 – 2006	Adviser to the Minister of Environment
1998 – 2005	Principal, National Survey and Cadastre, Denmark Responsibilities: Project manager on different national and international projects
1992 – 1998	Adviser to the Ministry of Lands, Resettlement and Rehabilitation – Department of Surveying and Mapping – Namibia Responsibilities: Design of a land registration system for urban informal settlements and development of the national survey organisation
1990 – 1992	Surveyor European Storebælt Group Responsibilities: Hydrographical survey and processing, land survey and setting out
1986 – 1990	Chartered land surveyor in two different private survey companies Responsibilities: Cadastral survey, land survey and survey of gas pipes.

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