Developing Cadastral Cross-Governmental Digital Administration

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SUMMARY

The use of the cadastral map as a cross-governmental reference layer is growing. Instead of just using the cadastral map as an index map in land registration systems when administrating ownership of land, cadastral maps are increasingly being used as a reference layer in multiple other public organizations when displaying and administrating various datasets. In the sense of digital administration, the emerging use of cadastral information in cross-governmental digital administration processes is of special interest. The focus lies in this regard on the need of public organizations to have their datasets linked to updated property boundaries. Examples are the administration of various administrative boundaries, e.g. the boundaries of municipalities or post districts, which most often follow property boundaries.

However, using the cadastral map as a reference layer is not straightforward. Challenges exist on the technological side, as well as on the more business focused side.

Taking Denmark as a case, this paper explores the demands for building an efficient system for using the cadastral map as a cross-governmental reference layer. Focusing on The Danish National Survey and Cadastre, the paper discusses the organizational and technological demands and challenges when developing and implementing such processes. Furthermore, the paper introduces an enterprise architecture model beneficial when using the cadastral map as a reference layer. The paper aims at discussing the practical use of the cadastral map as a key component in public digital administration.

The paper concludes that the cadastral data set can be so much more than just a tool for the land registry. Smartly used, it has the potential to act as an important element in any country's public geographical infrastructure. However, fulfilling this role is not an easy task for the holder of the data set. The paper proposes that if The Danish National Survey and Cadastre should succeed in expanding the role of the cadastral map as a reference layer, it is important that the organization strategically follows a path where it focus on its role as an infrastructure facilitator and developer in order of supporting the businesses of the end users. It is important to acknowledge than geographical data will not come into play if the professional public geographical organizations only act as data provider, and disclaim the important role as infrastructure agents.

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1 INTRODUCTION

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However, using the cadastral map as a reference layer is not straightforward. Challenges exist on the technological side, as well as on the more business focused side.

Taking Denmark as a case, this paper explores the demands for building an efficient system for using the cadastral map as a cross-governmental reference layer. Focusing on The Danish National Survey and Cadastre, the paper discusses the organizational and technological demands and challenges when developing and implementing such processes. Furthermore, the paper introduces an enterprise architecture model beneficial when using the cadastral map as a reference layer. The paper aims at discussing the practical use of the cadastral map as a key component in public digital administration.

2 TOWARDS DIGITAL ADMINISTRATION IN DENMARK

2.1 National strategy

In the last decade there has been a growing focus in Denmark on digital administration in the public sector. Digital administration is seen both as a mean to overcome the present challenges in government such as financial cut backs, and as a tool by which government can offer a better service for its citizens.

In the current national strategy, it is highlighted that geodata is regarded as cross-governmental reference layer that helps binding different sectors together (Center for effektivisering og digitalisering 2007). The new national strategy coming this year goes even further, since it focuses on the importance of geodata as a basis for public administration together with a number of other data sets.

2.2 The Danish National Survey and Cadastre

The growing focus on geodata as a tool for building an efficient digital administration has had a big impact on the role of The Danish National Survey and Cadastre. From being a

traditional mapping agency, the organization now fulfills the role as the national knowledge center for geodata, and has the responsibility for developing Denmark's national geographic infrastructure. Since the country is moving towards the implementation of a broad eGovernment strategy in which geodata will serve a central role, The National Survey and Cadastre plays an important role in promoting Denmark's goals for more efficient public administration.

3   THE USE OF THE CADASTRAL MAP AS A REFERENCE LAYER IN DIGITAL ADMINISTRATION

The development of the use of the cadastral map in the Danish public sector is a very good example of the changing focus of The National Survey and Cadastre. Traditionally the cadastral map has been used as an index map when administrating the ownership of land in the land registration system. In the last decade the cadastral map is also increasingly being used as a reference layer in conjunction with data sets from multiple other public organizations.

In general, the cadastral map is being used as a reference layer in Denmark in three different ways.

1. Presentation
   The cadastral map is being used as presentation layer, where the focus is on visual communication of cadastral information in interaction with other data, e.g. topographical maps or orthophothos. Examples are WebGIS solutions on local administrative homepages, see below.

Figure 1: Presentation of cadastral parcels on top of orthophoto (Jammerbugt kommune 2011)

2. Analyses
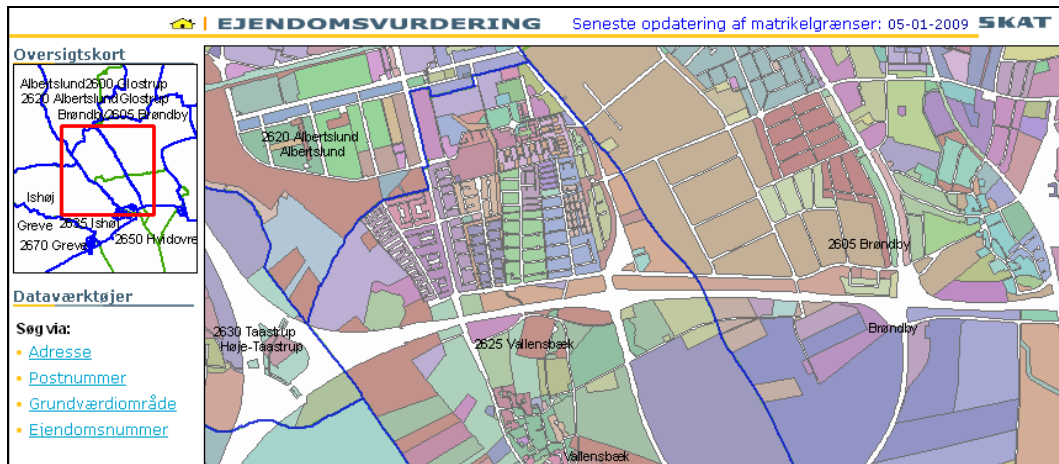   The cadastral map is being used in GIS analyses. Examples are analyses of property value, see below.

Figure 2: Analysis of property value (Kort- og Matrikelstyrelsen 2010)

3. Administration

The cadastral map is being used as an administration and registration layer in terms of the establishment of links between external datasets and cadastral boundaries or cadastral parcels. An example is the administration of polluted soil, which are represented and administered in an external database using the cadastral map as a foundation, see below.
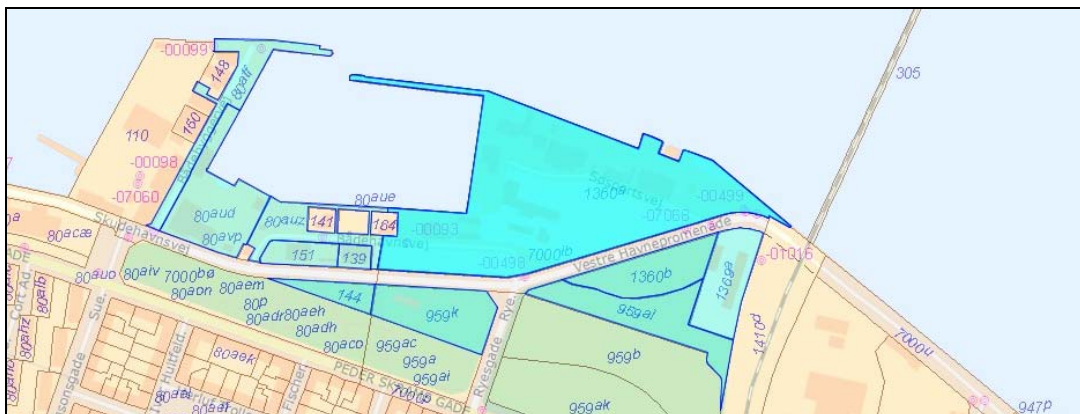

Figure 3: Administration of polluted parcels using the cadastral map (Miljøportalen 2011)

4   OVERALL TECHNOLOGICAL AND ENTERPRISE ARCHITECTURAL DEMANDS FOR USING THE CADASTRAL MAP AS REFERENCE LAYER

The National Survey and Cadastre encourages other organizations to use the cadastral map as a cross-governmental reference layer because of its practicability in visualizing information, its use when supporting property based analyses, and its administrative force when linking information to a common dataset. However, if the use of the cadastre as a reference layer should be even further expanded there is a number of data and service related issues that should be improved in order of satisfying new and old users. A user survey carried out in 2009 by The National Survey and Cadastre outlines the general demands the users have when

using the cadastral map as a reference layer:

"The users expect easy access to relevant, updated cadastral data in a form that makes it uncomplicated to use as a reference layer in a straightforward interaction with other datasets."

The below two sections will unfold the issues of importance both seen from a data viewpoint and from a more overall enterprise viewpoint.

4.1   Accessibility, actuality and accuracy

The users in the survey naturally had a big focus on the data since it was there primary focus in their business processes. In general, the users focused on three well-known aspects of data quality: Accessibility, actuality and accuracy.

–   Accessibility is important since the users make big demands for access to both data and metadata in different form and formats.

–   Actuality plays an important role in order of providing updated data to the users and ensuring updating procedures.

–   Accuracy is central since the use of cadastral data often happens in interaction with other datasets.

4.2   Enterprise architecture model

However, even more interestingly during the user survey in 2009, was the ability to sketch up an overall enterprise architecture model for the processes of the use of the cadastral map as a reference layer. This model adds a number of interesting points to the above data related issues. The below model illustrates this viewpoint.
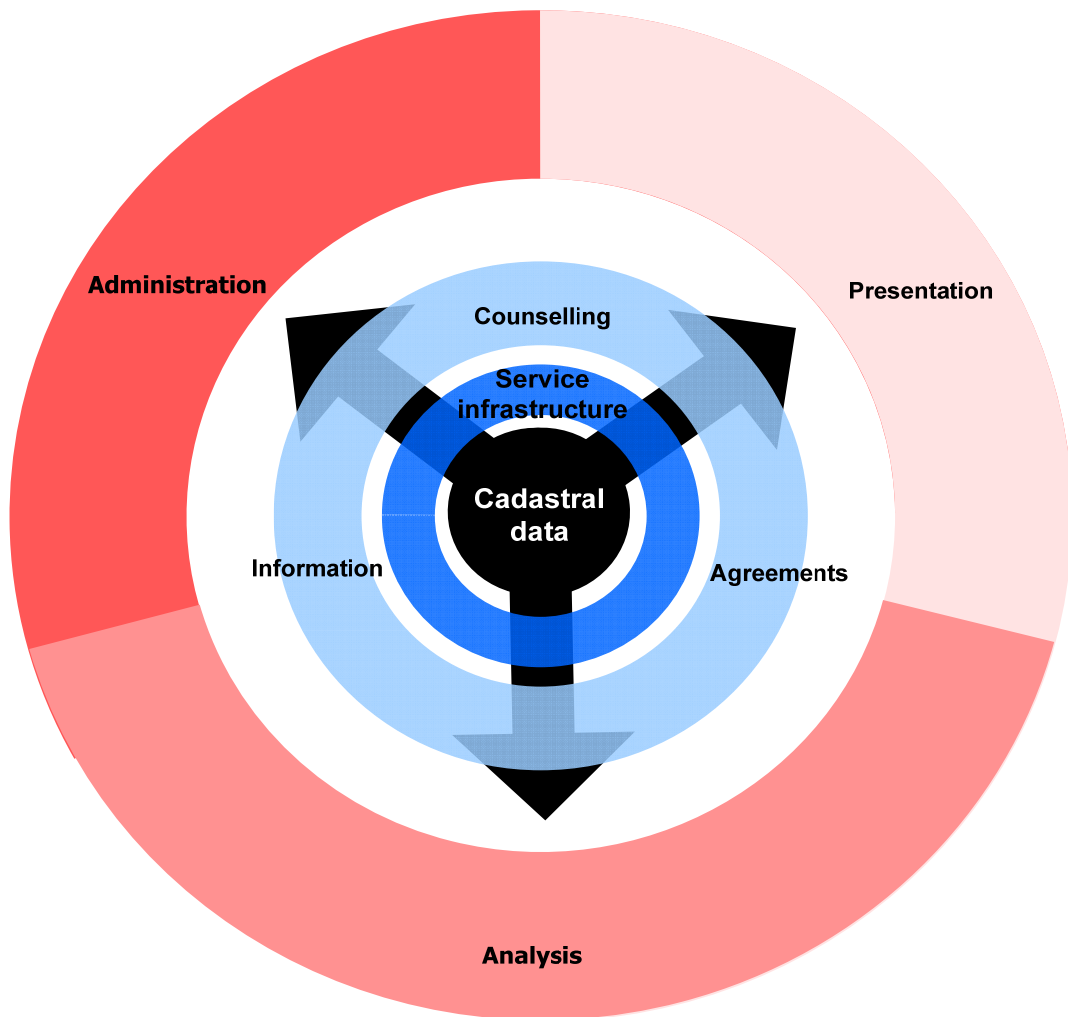
Figure 4: Enterprise architecture model for the processes of the use of the cadastral map as a reference layer

In the black core, the figure displays the cadastral data set to be used as a reference layer. The arrows pointing from the center illustrate how the data has to be supported by several layers of business processes before reaching the users in the outer ring.

1. The first blue ring illustrates the service infrastructure that makes the use of the cadastral data possible. Here we e.g. find services that give access to data (e.g. WFS) and services that can send information of changes in the cadastral data set.

2. The second blue ring illustrates how access to cadastral data also is depended in a number of business policies. As a foundation it is necessary to have an agreement for the use of data. In addition to this, it counseling on the use of data is a necessity, as well as continual information, e.g. regarding accessibility status for the data.

3. Lastly, the outer red ring illustrates the three main uses of cadastral data as a reference layer – Presentation, analysis and presentation.

5   CASES

In order of exemplifying how the above technological and architectural topics challenge the use of the cadastral map as a reference layer, the below sections unfolds two cases where the cadastral map is being used for administrative purposes.

5.1   Case 1: The administration of regulative planning info

5.1.1   Overall purpose

The cadastral map is being used as a reference layer in the administration of regulative planning info through the system PlanDK. In this system regulative plans are digitized using the cadastral map as base.

The overall purpose of the system is to deliver one national solution for the municipalities when registering planning info. As opposed to the past, a geographical user interface nowadays gives an easy access to all Danish regulative plans across administrative boundaries. Furthermore, the system helps to reduce double registrations and work as link to other systems. The system consists of:

- Information on the plans (identification and attributes)
- The present planning document (pdf)
- Geographical area of the plans (show on the map)
- Search possibilities
- Webservices that can send information on which plans that are applicable for a property, as well as which properties a plan covers.

The below figure illustrates how plans are presented in the interface on top of the cadastral map. It is possible to get information of individual plans by clicking on them in the window.
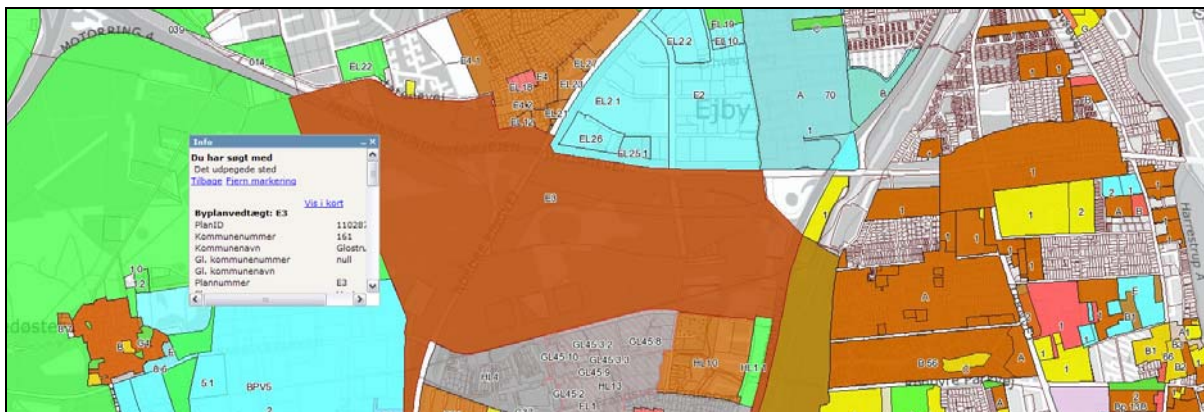

Figure 5: Regulative plans presented and administered on the cadastral map (Kort- og Matrikelstyrelsen 2010)

5.1.2 Actuality is crucial

The value in using the cadastral map as a reference layer for regulative plans exists in the fact that the plans always can be illustrated and administered on the actual property layout from the cadastre.

Therefore the system demands a close link between the properties outlined in the planning documents and the geographical representation in PlanDK. Furthermore, a system must ensure that property changes in the cadastral layer also are applied to the geographical outline of the individual regulative plans in PlanDK. Otherwise the representation quickly will be obsolete and of no use.

However, a big problem exists regarding PlanDK since no consistent updating procedures exist for the representation of the regulative plans when cadastral changes take place.

Today the municipalities that are in charge of updating the regulative plans in PlanDK use various procedures. However, a common characteristic is that the procedures are manual and therefore often sporadic and imprecise. The National Survey and Cadastre do offer an information service that can inform of geometrical changes in the cadastral layer and assist the updating procedures. Nevertheless, this service is seldom used in the procedures, since this demands a close integration between the digitized surfaces in PlanDK and the information service from The National Survey and Cadastre. A close connection that do not exist. The regulative plans are hence digitized on top of the cadastral layer, and not modually linked to the surfaces or boundaries.

This lack of integration means today that the procedures only can happen manually, and most often occurs on an ad hoc basis.

The bellow figure illustrates some of the errors that exist in PlanDK today because of the obsolete digitization processes and updating procedures.
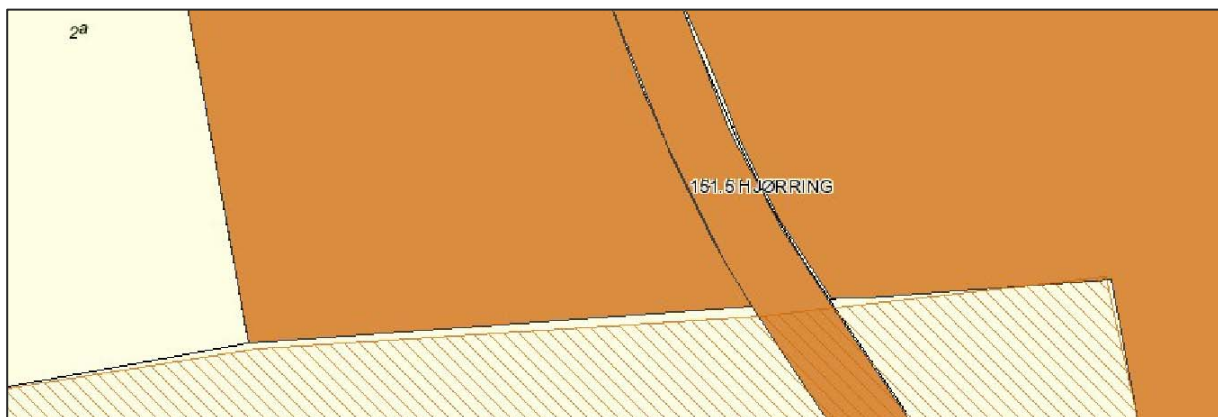
Figure 6: Gaps in the presentation of regulative plans (Kort- og Matrikelstyrelsen 2010)

The demands for links between cadastral data and external data sets, and for consisting updating procedures are conditions that are relevant for all the cases where the cadastral map is being used as an administrative reference layer.

The above case illustrates that The National Survey and Cadastre do offer some part of the solution in terms of its information service on cadastral changes. However, when the

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regulative plans not are linked to the cadastral parcel on the user side, but only digitized on top of these. This makes it hard to build a system that can take cadastral changes into account in a more automatized manner.

The next case displays another side of the challenge that occurs when using the cadastral map as a reference layer – the accuracy of the cadastral map. Here the problems not concern the use of the cadastral information on the user side, but instead the challenges that exist because of the occasional poor geometrical accuracy of the cadastral map.

5.2 Case 2: Georeferencing easements

5.2.1 Overall system and focus

In 2009 it became mandatory to geo reference easements in a new national data base. An easement is a non-possessory interest to use real property in possession of another person for a stated purpose. Examples of easements may be building restriction on top of pipelines, restrictions of building heights, traffic rights etc.

The data base is developed and maintained by The National Survey and Cadastre in commission for the Ministry of Justice who has legal responsibility for the content of the system. The focus of the system is to give property owners, lawyers and surveyors a comprehensive overview of the legal bindings on specific properties when administering ownership of land.

A typical procedure for registering an easements is that a surveyor measure or calculate the area of the easements and send in a GML-file to the system, which then automatically visualize it through an internet page, see below.
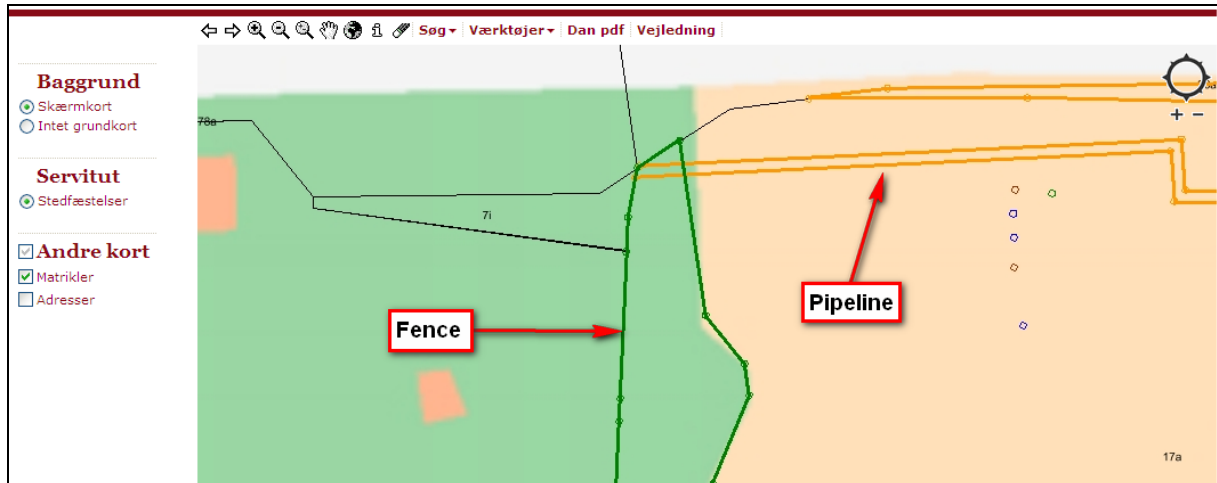

Figure 7: Easements are stored in a national data base (Kort- og Matrikelstyrelsen 2011a)

The figure demonstrates two easements in the database, a fence and a pipeline covering part of a cadastral parcel.

5.2.2 Methods of reference

There exist different codes on the easements depending on the method of reference. For example, if an easement covers a whole parcel it gets code M. Furthermore, easements may be referenced absolutely (code A) or relatively (code R).

Absolutely referenced easements may be the example above where a pipeline is precisely measured and its expanse represented on the map.

Relatively referenced easements on the other hand are linked to a cadastral boundary, and changes geometrically if the boundary changes. Examples are building easements that for example state that you must not build closer than 2.5 m to the cadastral boundary of the neighbour. If the cadastral boundary to the neighbour changes because of a cadastral adjustment, the boundary of the easement should change as well.

However, because of a poor geometrical accuracy in some parts of the cadastral map it has been necessary to introduce a mixed method between absolutely and relatively referencing called RA.

RA is used in this case: Imagine you as a surveyor have measured a pipeline in the field. Your accuracy is very high. You have been using your sophisticated (and expensive) GPS-equipment. But as you put your measurement together with the cadastral map in your computer, you find that the boundaries of the cadastral map are so inaccurate, that it in the map seems as if your measurement is located on the wrong parcel.

In this case the surveyor must either rectify the cadastral boundary through a case, or move the accurate measurement of the pipeline to a position where it is located on the right parcel, but wrongly in the map and use the RA code. The use of the RA code then actually tells that good measurements have been made bad. It is still possible to find the correct coordinates in the file, but the representation in the map is not correct due to inaccuracies.

5.2.3 Inaccuracy of the cadastral map

The inaccuracy of the cadastral map derive from the fact that a lot of the geometrical precision in the cadastral map of today originate from the original measurements from the 18th century. The below figure illustrates one of these maps, that were in function from 1811-1861.
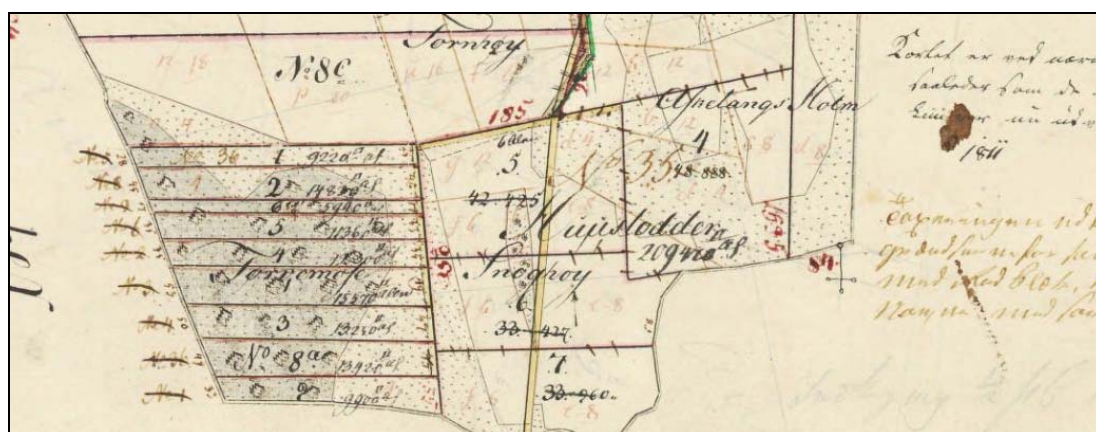
Figure 8: Section of map of Torup By, Besser, 1:4000 (Kort- og Matrikelstyrelsen 2011b)

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This means that only 60% of the cadastral points in the cadastral map today have accuracy better than 1 meter. For many purposes one meter is acceptable, however occasionally you may find examples like the one below where a systematically error of several meters occurs. These examples makes the use of the cadastral map as a reference layer difficult.

Figure 9: The Danish cadastral map is occasionally very inaccurate due to historical reasons (Kort- og Matrikelstyrelsen 2010)

6 DISCUSSION

6.1 Technological demands are not the only matter

Apparently, the above cases illustrate matters that manly concern two of the technological demands described earlier – actuality and accuracy. The first case on the use of the cadastral map as a reference layer for regulative plans described how obsolete procedures for cadastral changes had a negative impact on the continual actuality of the digitized regulative plans in PlanDK. The second case on the use of the cadastral map as a reference layer for easements demonstrated how a low geometrical accuracy could make the use of the cadastral map as a reference layer very problematic because of the imperfect procedures that have to be built in order to handle these problems.

However, looking closer into the cases, it is also clear that technological demands not are the only thing of interest. The enterprise architecture model in section 4.2 illustrated that matters of a service infrastructure and business policies such as communication, consultancy, and agreements also were important. In this case the big question is how far The National Survey and Cadastre wants to extend its services, when the use of a product as the cadastral map changes from being an index map to becoming a reference layer?

For example, how far should the service infrastructure reach in the case of the regulative plans? Today The National Survey and Cadastre do offer services that inform of the cadastral changes, but this information could be used much more intelligently at the user side. Should The National Survey and Cadastre expand its role and support or maybe even build business solutions for the end users?

Another example is on the case of the easements. To what extent should The National Survey

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and Cadastre improve its inaccurate cadastral data set in order to satisfy the new use of the cadastral map? Is the agency just a data provider where the users can take it or leave it?

Today this is unclear in the organization. On the strategic level, The National Survey and Cadastre do focus on expanding the use of the cadastral map as a reference layer. The strategic attention of the organization as a developer of Denmark's national geographic infrastructure implies this as well as the actual work the agency carry out.

However, in my opinion there is a general need to structure the organization differently if the organization wants to play a bigger role in regard to the use of the cadastral map as a reference layer. Especially it is necessary to further professionalize the business policies outlined in the enterprise architecture model in section 4.2.

In general, it is all about what business the agency wants to be. Should The National Survey and Cadastre focus on the delivery of geographical data, or should the organization to a greater extent focus on the delivery of services and solutions? Will the organization run a data warehouse or will it act as an infrastructure consultant?

6.2   Five levels of service

In order of specifying the above discussion, the below list outlines five levels of business service that may be applied to an organization like The Survey and Cadastre.

1. Data supplier – The National Survey and Cadastre supplies geographical data

2. Service supplier – The National Survey and Cadastre supplies services that enables an analytical use of the geographical data from the agency

3. Infrastructure facilitator – The National Survey and Cadastre supplies support that involves commercial counseling on the use of the geographical data from the agency in interaction with external data sets

4. Infrastructure developer – The National Survey and Cadastre supplies solutions for specific external use

5. Alliance partner – The National Survey and Cadastre supplies solutions where the procedures of the agency and the external user melts together

The below figure illustrates how the levels relate to each other, the level of cooperation, and the type of relation

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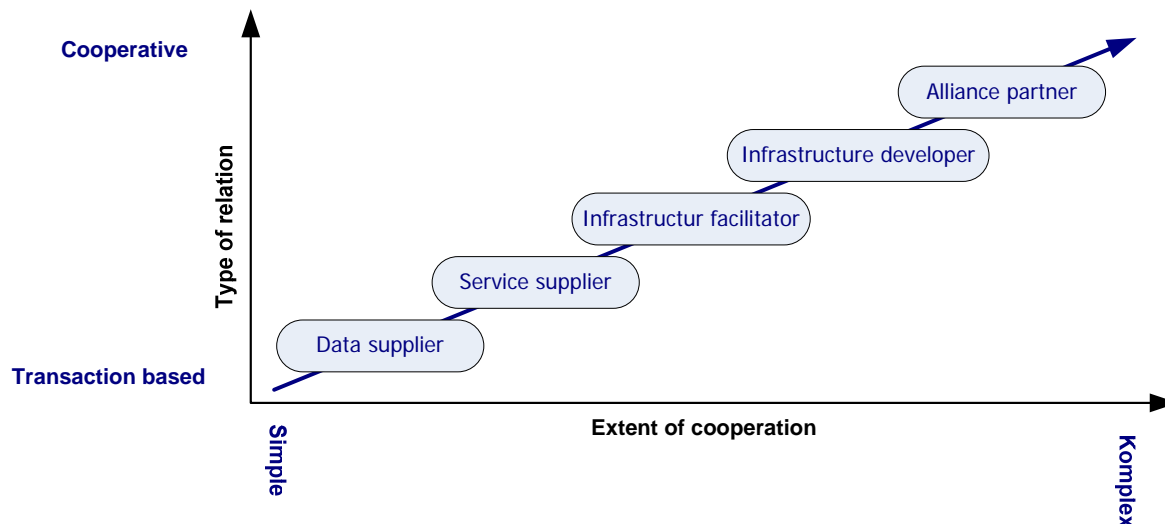Marrakech, Morocco, 18-22 May 2011

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Figure 10: It is possible to range the business services in an organization like the Danish National Survey and Cadastre in to five levels of service (Kort- og Matrikelstyrelsen 2010)

Even though the figure illustrates it, the five levels of service should not be understood as a sequence, where all the lower levels have to be fulfilled until you can reach a new level. Today The National Survey and Cadastre do operate on all levels. The use of the cadastral map as a reference layer is actually a good example of this.

The National Survey and Cadastre supplies data for the use of presentations (see section 3), the agency supplies a number of services through WMS and WFS, it does support counseling (e.g. on the referencing of easements), it does develop specific solutions where again the data base for the reference of easements is a good example, and lastly the agency can in several occasions be regarded as an alliance partner because of several cadastral procedures that are woven together with procedures from other public organizations.

However, the big question is whether The National Survey and Cadastre should focus even more on the top levels of the above model in order of getting closer to its strategic goal as being a knowledge center for the development of Denmark's national geographic infrastructure? It should be considered if The National Survey and Cadastre should move from its role as being primarily a data supplier to being primarily a company supporting geographical infrastructure.

Linking again to the enterprise architecture model in section 4.2 and the discussion of the use of the cadastral map as a reference layer in this paper, it seems necessary to focus more on the concepts of service infrastructure and business policies from an infrastructure viewpoint if a data set like the cadastral map should have more success as a reference layer especially in an administrative use.

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7 CONCLUSION

So what did we learn? Well above all, this paper illustrates that the cadastral data set can be so much more than just a tool for the land registry. Smartly used, it has the potential to act as an important element in any countries public geographical infrastructure.

Fulfilling this role is not an easy task for the holder of the data set. In Denmark, the two cases on the use of the cadastral map as a reference layer for the administration of regulative plans and easements demonstrate that both technological and more business policy related matters are important. The paper proposes that if The Danish National Survey and Cadastre should succeed in expanding the role of the cadastral map as a reference layer, it is important that the organization strategically follows a path where it focus on its role as an infrastructure facilitator and developer in order of supporting the businesses of the end users. It is important to acknowledge than geographical data will not come into play if the professional public geographical organizations only act as data provider, and disclaim the important role as infrastructure agents.

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BIOGRAPHICAL NOTES

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