Poul Daugbjerg

Product Development Dept.
National Survey and Cadastre- Denmark
Rentemestervej 8
DK-2400 Copenhagen NV, Denmark
E-mail: pd@kms.dk

Hanne Brande-Lavridsen

Dept. of Development and Planning
Aalborg University
Fibigerstræde 11
DK-9220 Aalborg Oest, Denmark
E-mail: hbl@i4.auc.dk

The Danish Spatial Data Infrastructure - a Research Initiative.

Abstract.
The Internet and other networked technologies are rapidly changing the geodata sector. In many ways this trend requires new market strategies, technical concepts and organisational approaches.
This is the background for the research initiative taken by a group of research institutions: Aalborg University, Copenhagen Business School and The National Survey and Cadastre.
Spatial Data Infrastructure should not be seen as a completely new research area but rather as an infrastructural view on the traditional reasearch areas. What is new is the integration of business and market research with technical research under this overall infrastructure view. The market for geodata is expected to expand and will consequently be an important driving force in the years to come.
Three research projects have been identified so far:
1. The GI Market: the networked GI product, market models (open electronic marketplace, closed networks), prizing and technological requirements.
2. Spatial Data Modelling and Cataloguing: restructuring spatial data from maps and registers into object oriented catalogues and spatial data models
3. Network Distribution of Spatial Data: practical application trials of the research results mentioned above

Background.

Denmark has a wide range of geographic information (GI). Over the past two decades the existing analog maps and georeferenced registers have been converted to a digital form and new data have been created to fill the gaps. Digital maps and georeferenced attribute files are now at our disposal within the traditional user areas and, what is more, with a national coverage.

After a few years of hesitation many public authorities at all levels are implementing information systems based on GI. We have not yet experinced a breakthrough in the private sector on a broader scale, but the Internet is accelerating the use of GI.

Denmark seems to be in a favourable position to profit by the present and past accomplishments in the GI field. However, the following issues should be taken into consideration:

Dublication of registration is seen within certain areas. This is mainly an organizational problem. Some organisations are unwilling to share or to coordinate data production. Data collected at local level are not available on regional or national level - and vice versa. Even public authorities may see themselves as competitors, which in fact is true since charging for spatial data was imposed on many public authorities in the late 80'es and early 90'es. Private

and semi-public bodies spend ressources in producing basic GI whereas no extensive value-adding production circle has come into existense.

Data are organised and used traditionally, i.e. the full potential of the conversion from analog to digital form is not exploited. The map has been moved from the desk to the screen but workflow and service concepts are basically pretty much the same as they used to be.

Network based technology and location sevices via the Internet calls for new strategies, especially in distribution of GI

The Infrastructure concept [1]

The infrastructure concept adopted by a number of industrialised countries to cope with the challenges of geodata supply on a societal level, seems to offer a favourable framework also for the Danish development of national strategies in the geodata sector.

The infrastructure for spatial information in Denmark focuses on technologies, strategies and rules necessesary for an economically efficient development and use of spatial information. Promoting the common use at all levels and across the public administration, private enterprises and academic sector seems to be a precondition for efficiency. This definition is preliminary and needs to be discussed on a broader scale involving all parties in the GI sector.

The infrastructural view focuses less on the individual data collection than on what is in between: connectivity, interoperability, coordination of semantics and supply and the like.
Many of these considerations have already been taken in a number of different ways in the past years, which means that we have isolated elements and embryo structures - but we still need to fit them together and form the overall infrastructure.

Establishing the infrastructure represents a collective proces and will involve many different parts of society. It is not somthing that emerges overnigtht but will take years to develop.

International reviews have emphasized the political support as necessary for a successfull spatial data infrastructure. In Denmark, there is a political interest for IT-policy in general. In November 1999 the government published its IT strategy. According to this, citizens and enterprises should have access to and profit from the investment in public electronic data collections already in place. Furthermore, efforts should be directed towards a better and cheaper service in public administration based on electronic communication with the citizens and the enterprises.

There is a general understanding and committment to coordination within the public sector, which has been practised for many years.

But a scientific research effort from different research fields is needed to support the strategy of the government and to benefit from the efforts of the geodata sector to develop the Danish infrastructure for spatial information.

Spatial Data Infrastructure should not be seen, however, as a completely new research area but rather as an infrastructural view on the traditional reasearch areas. What is new is the integration of business and market research with technical research under this overall infrastructural view.

[1] Based on a joint research program proposal by Hanne Brande-Lavridsen, Bent Hulegaard Jensen, both Aalborg University, Mogens Kühn Pedersen, Copenhagen Business School, and Poul Daugbjerg, National Survey and Cadastre

The research agenda.

The Danish spatial data infrastructure research initiative was taken by three institutions: Copenhagen Business School, Aalborg University and National Survey and Cadastre - Denmark. All three are established research institutions, the last two of them with a traditional background in the field of spatial data research.

Three research projects have been identified so far:

1. The Geographic Information Market[2]:
Digital spatial data has untill now been offered on a limited market mostly to professional users. Restrictions of many kinds (formats, data structure, skills, organizational etc.) have impeded the use of spatial data on a broader scale.

The networked technologies are expected to change that situation radically because they will expand the market for spatial data as has been the case for other digital data in the last few years. The market is a vehicle for allocation of products and will as such have implications on the spatial data production, distribution and the demand for GI.

One crucial property of spatial data is the updating frequency. The commercial market will reflect the different users concerns for the risk of using outdated data and the demand for spatial data which is updated at short notice is expected to increase. On the other hand, the technological development is in favour of this trend, with the fast growing integration of GPS technology into industry products. New communication technologies as General Packet Radio Service will favour both production and the use of spatial data.

The technology will also open a new market for "temporary spatial data", i.e. spatial data that describe a temporary situation, which is of interest to a certain number of users. For instance the traffic situation on the main routes to city center in the morning and afternoon rush hours.
We will go from a passive to an interactive culture. This means that we will all become active users of spatial information - and probably also producers by virtue of the new mobile technologies for positioning.

However, the new network based market for spatial data is different from the conventional market. The price of data must among other things be adjusted according to the general property of digital data: Data can be copied and sold an unlimited number of times without loss of quality and data can also be used any number of times at marginal costs.

In the research project different market models for digital spatial data will be described and analyzed.
The research will also involve the actors in the market, which to day is characterized by interaction between a few professional actors, many of whom are both producers and users.
The normal market will be an open electronic marketplace. But also "clearing houses", i.e. a closed network of spatial data producers that exchange updated transactions on a day-to-day basis with no or little money involved, will also be possible.

[2] Based on a project proposal by Mogen Kühn Pedersen, Copenhagen Business School: Electronic Markets for Real Time Spatial Data. September 2000

2. Spatial Data Modelling and Cataloguing[3]

The Danish spatial data are traditionally organised as maps and georeferenced attribute files, some of them with a very long history. In the conversion process these maps and registers have been maintained with their separate product specifications which means that we still have a cadastral map, a topographic map, technical maps etc. - but now in a digital form.

One consequence of this approach is duplicate registrations of some real world features. For instance the building feature can be found in the topographic map, in the technical maps and in the buildings and dwellings register as well. Each of these registrations are produced and maintained according to individual procedures and by separate organisations.

This duplication may in some instances be appropriate but seen from a social point of view this situation causes extra cost for the Danish society and the users are forced to deal with incompatible registrations to chose from.

The research project is expected to develop methods to restructure spatial data from maps and registers into object oriented catalogues and spatial data models. The object catalogue should be limited to the objects of general interest and duplication should be eliminated. The strategy would then be to concentrate production and coordination efforts to these objects and eventually improve quality and reduce the cost of production and maintainance.

Further attention should be offered to the objects with referential capabilities, i.e. georeferenced identifiers such as adresses, districts, plot and house centroids etc., since these are useful for establishing the basic structure of new registrations.

Datamodelling will have to take into consideration differences in semantics and to deal with modelling of multidimentional data, different levels of generalisation and the organisational set-up necessary to accomplish the restructuring process from the present heterogeneous datasets.

From a user's point of view, the object oriented catalogue and spatial data model should form a much more flexible basis for shaping individual spatial data combinations according to their individual needs. This is not in the least with the emerging web-based location services in mind.

3. Distributed Geographic Information Prototype[4]

Distributed Geographic Information (DGI) is referred to as the term covering mainly Internet/Intranet based location services. This is already rapidly establishing itself as the main distribution channel for geographic information.

In Denmark many authorities and commercial enterprises adjust their strategies to a DGI approach. By early 2001 the Ministry of Housing and Urban Affairs will have implemented a web-based Public Distribution Server for property data (georeferenced textual data) and it is expected to expand its data offers in the years to come.

The National Survey and Cadastre offers cadastral vector map data via a web server mainly to the professional users and a number of private location services have already been operational for some time.

The research project is intended to produce an experimental web-service based on the object catalogue and spatial data model developed in the previous research project mentioned above.

---

[3] Based on a project proposal by Poul Daugbjerg, National Survey and Cadastre: Restructuring and Modelling of Basic Spatial Data, March 2000

[4] Based on a project proposal by Bent Hulegaard Jensen, Alborg University: Application of Internet Technology for distribution of Spatial Data, March 2000

The intention is to analyse selected use cases, test the usefullness of the object catalogue and spatial data model for individually adapted services and to evaluate the commercial viability of DGI.

Foreign sample geographic web-services will be examined to characterise different approaches and evaluate their advantages and disadvantages.

Where are we now?

The research initiative has been taken in a favourable international situation as experiences can be gained now from a number of national infrastructure initiatives (USA, Australia, Portugal, Canada etc.). The international efforts towards standardisation in CEN, ISO and OGC will eventually show results after many years of considerations.
As far as possible the research projects will seek compatibility with emerging international standards.

The research project mentioned on spatial data modelling and cataloguing has been started this summer in a cooperation between The National Survey and Cadastre and Aalborg University, under the supervision of professor Christian Jensen, Dept. of Computer Science.

The Geographic Information Market research project is planned to start early next year and will be headed by professor Mogens Kühn Pedersen, Copenhagen Business School, Dept. of Informatics.

The Distributed Geographic Information Prototype is planned to start on the basis of results achieved in the other two projects.

Interaction with spatial data infrastructure researchers outside Denmark will be much appreciated.