ELEMENTS OF INTEGRATED SYSTEMS FOR INFORMATION SERVICES

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ABSTRACT:

From cost/benefit analysis of geographical information it is well known that the benefits increase significantly as the data can be utilized by several parts of an organisation or by different organisations. The use of geo-data is facing several barriers; legislation, pricing, and lack of metadata or difficult access to metadata or data itself. Increasing awareness on geo-data is seen from the growing number of co-operate organisations and from new and creative services from data-suppliers.
The aim of this paper is to illustrate – by means of examples and links – the varieties and potentials of services facilitated by the Internet and provided by governments, municipalities, and private companies. The services range from simple home pages to interactive services where geo-data, information, software toolboxes and GIS applications are made available for the user.

1. INTERNATIONAL ORGANISATIONS

Several international organisations deal with geographic information dissemination providing a variety of services. A few examples are listed below.

EuroGeographics is the grouping of the heads of European Official Mapping Agencies. Currently it has members from 37 nations. Development of geographic information in Europe is the main objective of the organisation, primarily by working to make the data bases of European NMAs interoperable, and widely available. The homepage of the organisation holds links to all member countries and their metadata sites (EuroGeographics, 2002).

The Committee on Earth Observation Satellites (CEOS) was created in 1984 with the primary objectives to optimise the benefits of space-borne Earth observations. Points of contacts are ESA, NASA/NOAA, STA and NASDA. Of particular interest is the CEOS working group on Information Systems and Services, WGISS. WGISS was established in 1995. WG II/3 of ISPRS Commission II has the contact to WGISS (CEOS, 2002).

Environmental European Spatial Data Infrastructure (E-ESDI) is a EU-commission initiative in order to make relevant geo-information accessible for EU institutions and citizens. The aim is to create a forum for discussion, implementation and monitoring the EU environmental policy. The initiative focuses on

- easy access to geo-data
- seamless combination of data across Europe
- data acquisition only once
- optimal maintenance of data

The E-ESDI aims at establishing an infrastructure for geo-information concerning the environmental sphere. It is expected that concepts developed in this framework will be extended to other sectors. The E-ESDI has recently been renamed to INSPIRE (Infrastructure for Spatial Information in Europe), which also indicate the generality of the initiative. Related to this is an expected EU-directive stating that data produced as spin-off from administrative tasks should be available at no cost, while data produced from national mapping agencies will be object for a pricing policy (INSPIRE, 2002).

Global Spatial Data Infrastructure (GSDI) is a global umbrella organisation, which brings together national and regional committees and international institutions. The definition of GSDI adopted at the 2nd GSDI Conference is: "GSDI encompasses the policies, organisational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the global and regional scale are not impeded in meeting their objectives". GSDI relates itself closely to the 1992 Agenda 21 of the Rio summit and other multi-national environmental conventions. One of the major achievements is the SDI Cookbook, which is a collection of "recipes" for implementing SDIs.

The Cookbook addresses
- geo-spatial data development
- metadata
- geo-spatial data catalogue
- access and delivery
- local, national, regional and global case stories

(GSDI, 2002).

2. SERVICE COMMUNITIES

Spatial Data Infrastructure or *Spatial Information Infrastructure* is together with e-government, e-commerce, participation democracy, geo-visualisation and training an important element of *Spatial Information Management.* The top-down approached of SDI based on legislation is found in some countries while the bottom-up approach develops from existing organisations or new co-operates (Brande-Lavridsen, 2002a; Brande-Lavridsen, 2002b). In any case, a formal or informal SDI/SII is a prerequisite for an integrated service provided by more collaborators.

The NMAs or other national authorities like ministries, counties and municipalities manage the dissemination of data from public databases in different ways. Data may be classified or restricted or managed on market conditions in a customer/contractor relationship. The trend is two-sided, i.e. an information market where geo-spatial data and related services are distributed commercially and at the same time certain public information disseminated at no costs.

Data- and service-communities should design a framework that describes how geo-data services can be established and maintained. These services should be Internet based and enable users of geographical information and GIS functionalities to define their own applications.

3. METADATA

It is generally believed that around 80% of the content of public databases is geographically related, directly by coordinated or indirectly through addresses. The amount of data and the growing number of databases are one of the main reasons to create metadata on geo-information.

The metadata concept has been implemented for more than a decade and as the amount of geo-information increases – and it tends to increase exponentially - metadata becomes more and more important. The metadata concept is a matter of identifying data and the history is behind it.

Metadata is organised in databases. The aim of a metadata base is to offer an overview of accessible data and enable the user to navigate in the "information jungle". The purpose of a metadata base is also to establish contact between data producer/owner and user/customer. The term Data Warehouse is used to describe the functionality where the first step for the user is to establish an overview of available databases. Next step is to select the relevant database and finally to extract the information desired.

The SDI Cookbook mentioned above gives a comprehensive description of metadata, standards, organisational and implementation issues. (GSDI, 2002)

Obviously, metadata is an important component in the information society and important for the operability of information services. But also on the international level a catalogue of organisations each managing its own metadata on geo-information would be desirable. Internationally, we can talk about meta-metadata.

4. GEO-INFORMATION – REGISTERS

Information of interest for citizens, authorities or enterprises is not necessarily found at a single authority. Data are often stored in central databases managed by different authorities in different computer centres. Direct access to these databases is normally limited or impossible. Different database systems are in use on different platforms. One of the challenges is therefore to create a service concept characterized by a simple, standardised and easy access interface to relevant databases.

An example, on the way to develop an integrated information service, is the "Public Information Server" initiated by the Danish government (Ministry of Housing, 2001; Brande-Lavridsen, 2002a). It is a computer system that links public registers and handles extracts and dissemination of data from a number of computer centres to citizens or data-distributors. The content of the registers relates to buildings and properties (figure 1).

The purpose of the Information Server is to pre-process and link data to meaningful and useful information for the user. The main key in the system is the address. At the moment the following registers are accessible through the Information Server:

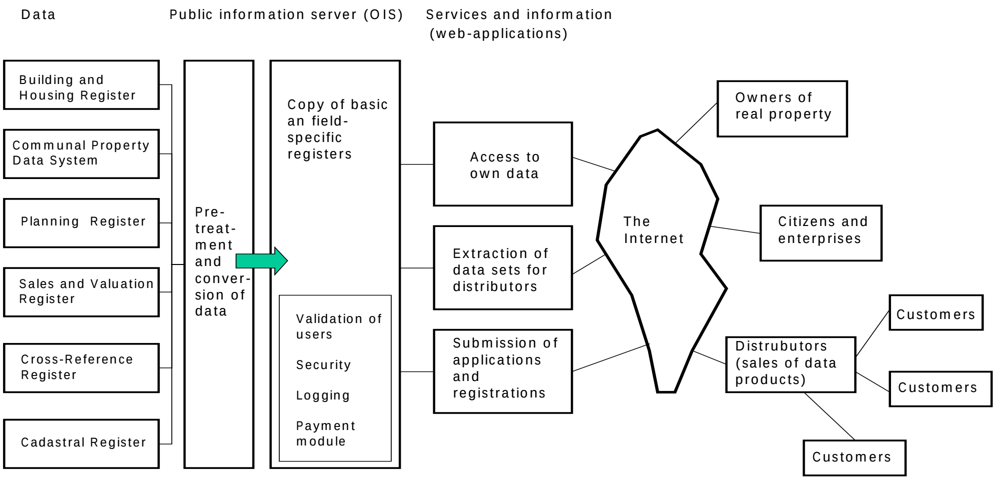

Figure 1. The public Information Server links a number of public registers to useful information for the user (Brande-Lavridsen, 2002a).

- Building and Dwelling register – technical data about buildings updated by municipalities
- Property Data System – information relevant for valuation maintained by municipalities
- State Sales and Valuation Register – calculation and collection of taxes
- Cadastral Register – central registration of all properties, relates to cadastral maps and the Land Registry
- Planning Register – data registered and used by all levels in public administration
- Cross-Reference Register – is not really a register but comprises common keys and key-relations in order to access the other registers.

5. GEO-INFORMATION - SPATIAL DATA

An Internet service should manage an integrated handling of register data, graphical data and related attribute data. The user-interface should preferably be graphical and include a search facility based on positions or addresses in order to locate the field of interest.

The matrix shown below illustrates some of the requirements and capabilities of vector- and raster data in a service context. The *GIS map – full dataset* can be applied to all functionalities whereas the *Basis Internet* indicates a dataset with reduced functionalities available for the user.

The matrix also shows possible functionalities in an Internet based service where a number of functionalities must be pre-requisite. These functionalities should come with a basic subscription on the service while the number and complexity of the functionalities should increase as the subscription is extended.

6. PRICING POLICIES

The pricing is one of the most complex elements in geo-data dissemination. It depends on political and economical conditions rather than geo-data itself.

It is often claimed that public produced and owned data, i.e. data paid by the taxpayers, should be available for everybody at no cost. This is named the Public Domain model and is one of 4 models analysed in the report Tarification Strategies for Geo-data from a GIS working group of the Swiss Conference on Informatics (SIK-GIS, 2001).

The four models are:

- Public domain model, where data are disseminated at no cost for the user.
- Low cost model, where the customers are only charged dissemination costs.
- Model based on partial return on investment, where - in addition to dissemination costs – the customers also pay for a portion of the maintenance and/or creation of the data.
- Full cost model, where the customers are charged full cost of data collection, maintenance and dissemination.

The *full cost model* applies to the private sector in an ideally competitive market handling geo-data products directed towards a specific market segment or produced on demand for instance through a tender. The model is not likely to work on geo-data produced for general purposes, as is often the case for public data. The total costs are simply so high, that a demand for complete recovery of costs by the customer would lead to a situation where data is only used by its public owner.

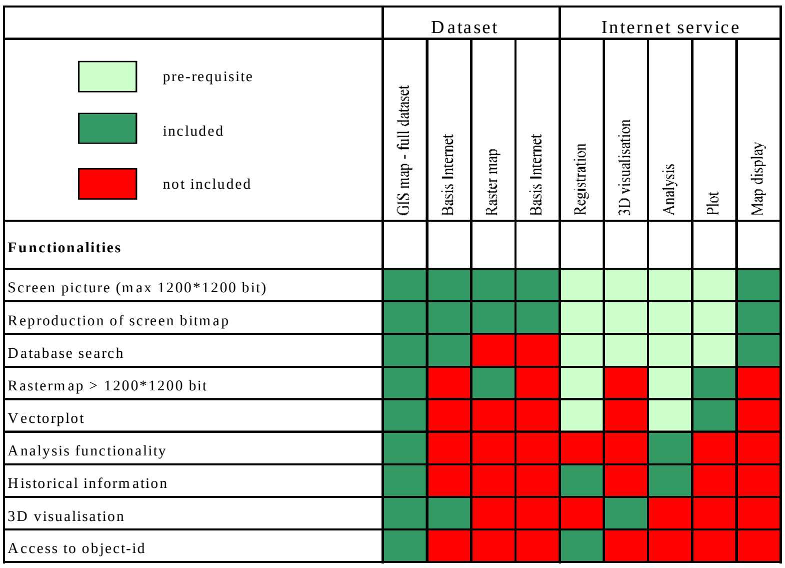

Figure 2. Relations between vector and raster data, functionalities and possible Internet aervices

The model based on *partial return on investment* aims at recovering a pre-decided portion of the full costs. Typically, the costs paid by the customer in this model are calculated from the maintenance and dissemination rather than the data collection expenses. The portion of the costs paid by the customers can be adjusted according to political decisions or determined by another model based on parameters like the customers capability, use of data etc. A user with high frequency data extraction needs from a database may pay less per access than a user with occasionally use of the service.

The *low cost model* is based on the principle that the customers should cover costs related to extraction, copying and distribution. From the data owner's point of view the model has no influence on the quality of data. It is central administration data and the customer can have it on a take it or leave it basis.

The immediate reaction to the *public domain model* is normally that it ensures the maximum dissemination and use of geo-data. Data is provided at no cost and also to users who are willing to pay for data. All expenses are financed out of public funds. As with the low cost model, duplication of data in the community can be avoided, as there is no motivation to do so, provided data meets specific minimum requirements. The SIK-GIS report states, that the long-term maintenance of geo-data is endangered and sensitive to political changes. The psychological factor that data received at no cost is not taken as seriously as data purchased at full or reduced costs, should also be mentioned.

In the future it is likely that public owned geo-data and related services have to be divided into groups depending on origin, producer, production circumstances etc. Each group will then have its own price model – one of the above mentioned or variants of them – depending on a possible competitive situation with the private market, where a full cost model normally applies.

7. INFORMATION SERVICE - AN EXAMPLE

An example of a web-based geo-data service is the Map Service (Kortforsyningen, 2002) developed by the National Survey and Cadastre - Denmark. The service gives on-line access to updated topographic and cadastral information and maps via a standard interface. It is directed towards GIS application developers and enables them to use on-line maps and registers as an integrated part of a user designed solution. It is an API (Application Programming Interface) and based on the WMS standard from the OpenGIS consortium (OGC, 2002).

The user can work directly on a number of databases and include data in analysis or documents through a standard browser.

Maps are delivered as raster files in PNG or JPEG format with a size varying from 100*100 to 1000 *1000 pixels. The maps can be delivered as transparencies for use together with orthophotos or other raster images. The user defines the map from a set of co-ordinates as an area of interest and from the image size.

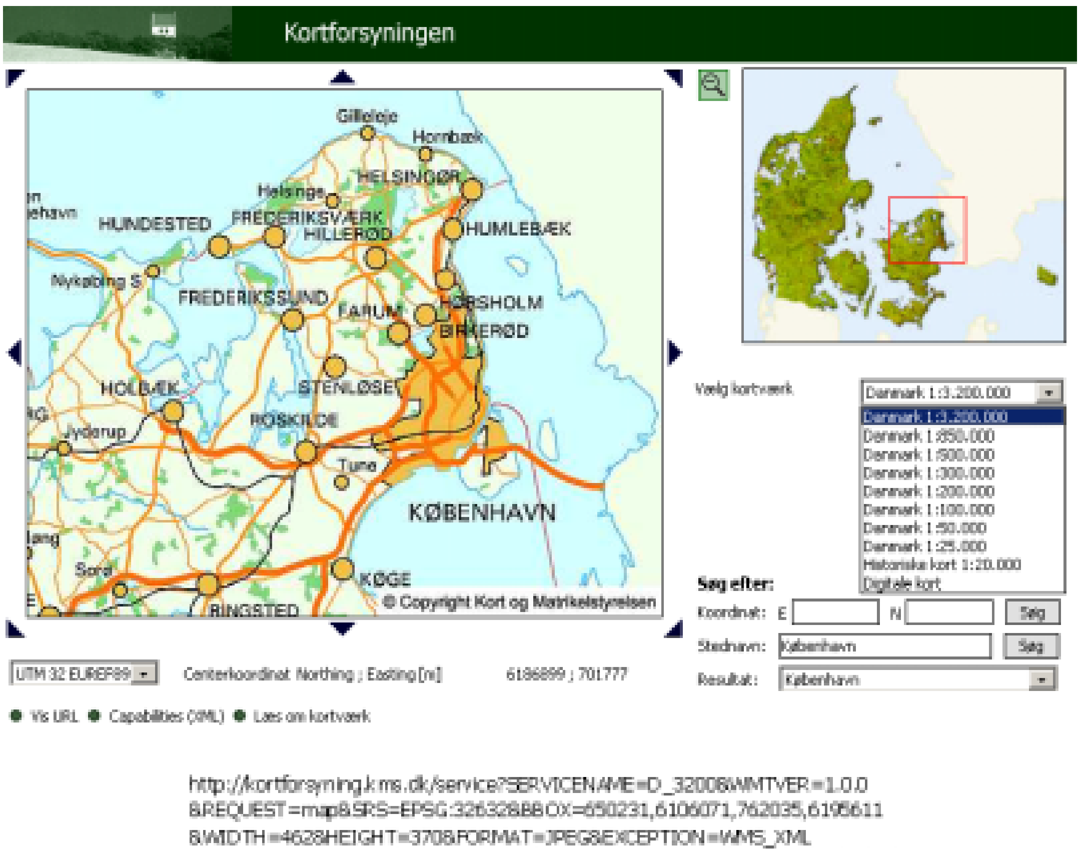

Figure 3. The Map Service of National Survey and Cadastre – DK. Map displayed on the screen and the corresponding URL. The position on the map can be identified by the name of the location or by co-ordinates.

The service is based on nationwide series of small and large-scale maps. The most important are:

- TOP10DK – a 3D topographical vector database with the reference scale 1:10.000. The accuracy specification is 1 meter in x ,y and z.
- Cadastral maps – digital cadastral boundaries (vector) original produced in scale 1:4.000.
- Topographical overview maps in scales ranging from 1:3.200.000 to 1:20.000 in raster form. Also historical maps are available in raster form.

Standard layouts for the various map types are offered as part of the service. The maps are updated according to their specifications – the cadastral map is updated on a daily basis while the other services are updated 4 times a year.

The service includes functionalities for geo-coding of addresses, cadastral numbers, names of places and for some map series also an option for queries on objects. A co-ordinate transformation is part of the service in order to match data extracted from different databases.

Except for demonstration purposes, the Map Service is subscription-based on different levels. A subscriber has access to full documentation of the APIs and a toolbox designed for extraction of maps into a number of GIS and administrative applications.

The pricing policy and the payments arrangement of the Map Service is under development. It may include a differentiated model where the customer pays according to area extracted, number of database search, number of applications available etc. For public customers like counties and municipalities the dominant factor might be the population size.

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