Database for the 1:10 000 map of Sweden

LARS OTTOSON, Gävle

ABSTRACT

The paper reviews the activities of building a national geographic database basically containing the information shown on the fundamental official map of Sweden, the so called Economic Map. Photogrammetric methods are used in data capture and updating of the database. Digital ortho photos are planned to be used in connection with this database.

1. BACKGROUND

The basic official map of Sweden produced by the National Land Survey, NLS, is the so called Economic Map. Economic Map production in its present form started in 1937. The production of the map series was preceded by comprehensive development work during the early 1930's. At that time photogrammetric techniques had been introduced in mapping activities abroad. In Sweden, however, photogrammetry so far had been used only to a very limited extent. The first pilot studies for the economic mapping was in fact carried in cooperation with German experts. As a result of these experiments it was decided to base the Economic Map production on a photo mosaic. After the acquisition of a first Gigas Zeiss ortho projector in 1966 the photo mosaic as base material was successively abandoned in favour of ortho photo maps.

Initially the map was mainly used in planning for agricultural and forestry purposes. Later the map has been used more and more in planning of roads, railroads etc. In addition Economic Maps have become indispensible for most surveying activities mainly due to the excellent summary of the real estate property sub-division situation shown on these maps.

The Economic Map covers some 85% of Sweden. The map is not produced for the north-western part of the country, which is a region of mountains and broken upland of limited value for farming and forestry. The map scale for the main parts of the country is 1:10 000. For sparsely populated areas in northern Sweden the map scale is 1:20 000. Map sheet size is 50x50 cms which gives is a total number of about 13000 sheets. Some ten years ago it was decided to make use of the scale of 1:20 000 for the whole country when printing the maps. Then the map series has been published under the name of the Yellow Map (Gula kartan). However, the map scale when producing the map has remained 1:10 000.

The map series was completed in 1978 after some 30 years of production. Since then only revision and updating has been carried out. The production has undergone a successive development. Already in the beginning of the 1970's computer controlled flatbed plotters were introduced in order to rationalize map production. A full change-over to a digital production line was made some years ago.

NLS has been working with the establishment of geographic databases for several years. For natural reasons these activities in the first place comprised databases based on data captured from small scale maps. During later years some important users have demanded digital databases based on the Economic Map series. In particular the Swedish Telecom showed great need for an Economic Map database. To meet this demand an agreement was met between NLS and Telecom to digitise the Economic Map series during a five year period.

This agreement was made in the autumn of 1991. Since then agreements have been made with some other interested bodies like the National Road Administration and the State Power Board.

2. DATA ACQUISITION

2.1 Data content

Basically the content of the database corresponds to the map content. However it has been decided to exclude some objects in order to in order to facilitate and speed up data capture. The objects excluded have been judged to be of less importance for database users.
Thus elevation contour lines are not included in the database. Users needing information on elevation conditions can make use of the national elevation database. Moreover the ortho photo background is so far not included. However, as will be discussed in section 5, we plan to include digital ortho photos later on. Some planimetric details like footpaths and minor ditches are omitted as well as part of the place names.

2.2 Data acquisition methods

The fundamental conditions for data acquisition vary for different parts of the country. This is due to the fact that the age of the existing maps may vary within a time interval of 25 years.
The data capture comprises some 13000 sheets each covering an area of 5x5 kms. Due to the relatively short time of five years available for data capture it has been found neceessary to use different methods.
As far as possible we are trying to make use of photogrammetric data acquisition techniques. This will certainly give the best geometric quality and will also provide z-coordinates for all details captured from aerial photos. This photogrammetric compilation is based on the use of aerial photos taken at an altitude of 4600 metres which equals to a negative scale of 1:30 000.
The photogrammetric work is carried out at production centres in Gävle, Luleå and Karlskrona. All this work is performed in Zeiss analytical plotters with Phocus software. The compilation is preceded by block triangulation which is carried out in Zeiss analytical plotters as well.
The photogrammetric data capture comprises buildings, roads and railroads, hydrography and farmland. Other details, in particalar property boundary lines, are digitised from manuscripts.
The photogrammetric method will be used for some 5000 sheets. For the rest of the area data are captured by digitising manuscripts or existing maps. To a limited extent this digitisation is carried out by scanning with subsequent vectorisation of raster data. The main part, however, of the digitisation will be carried out by manual digitising since scanning has been found to be ineffective in most cases.

3. ARCHIVING

Storage of Economic Map data calls for an efficient system, which also can be used in updating and distribution of data. The data will require a storage space of approximately 2 megabytes per sheet. Thus in total the storage requirement is about 25 gigabytes.
NLS has developed the so called Geodatabank system which will be used for storing data in a seamless database. An important feature of the system is a possibility to mark all objects with birth dates. This facility makes it possible to find which objects have been changed or added within a certain period of time. This is of particular importance regarding real estate property data. It is also possible to check out data to a local PC and then update the central database in a differential way.
To verify the database content a special base certificate in map form is plotted. This verification plot shows the base content at the time when all abjects within a particular map sheet has been stored in the Geodatabank. The plotting is normally made on film in our Barco 3800 laser raster plotter which means high cartographic and geometric quality.

4. UPDATING

4.1 Updating methods

A special problem is certainly the updating of the database. So far very little experience has been gained simply because this activity has not yet been started. Anyway different methods and time intervals will be used in the updating process. Thus property information will be updated continously. This updating is carried out by our regional offices and is normally based on geodetic measurements.
Updating of topographic information will to some extent also be carried out by the regional offices. This applies for roads and buildings. These objects will be revised every year. However, it will normally not be possible to make this updating with a high geometric quality. So this updating is preliminary and the updated objects are marked in a special way in the database.
A more accurate revision of topographic objects will be carried with a time interval of 4-6 years with photogrammetric methods. In this case Zeiss analytical plotters with superimposition will be used. Aerial photos from an altitude of 9200 metres at a negative scale of 1:60 000 will be used as a base material for this compilation.
One problem with this revision method is that z-coordinates are not available in the database for objects captured from existing maps. However, the national elevation database can be used to interpolate z-values for these objects. The tests carried out to investigate this method has shown that it will work with sufficient quality.
To some extent it will be possible to co-operate with other authorities in updating the database. Thus we have now made an agreement with the Central Board of National Antiquities regarding updating of ancient monuments. This authority will update these objects directly in our database. In the same way public roads will be updated by the National Road Administration. Hopefully it will be possible to make agreements with other central or local authorities to help us in the updating process.

4.2 The national elevation database

Already at the end of the 1970's NLS started the establishment of a national elevation database. In the first place this database was built up in order to rationalize the ortho photo production for the Economic Map. The database has recently been completed and covers the whole of Sweden.
Data have been acquiced mainly by photogrammetric techniques. Thus to a very large extent it was possible to digitise existing so called profile plates which had been scribed in the Gigas Zeiss ortho projection system. For some areas photogrammetric profile measurements were used in the data acquisition and for remaining areas elevation contour lines were used as basic source material.
Elevation data are stored for regular grid points with a spacing of 50 metres. The accuracy is estimated to 2.5 metres.
Elevation data have been used for many purposes apart from ortho photo mapping especially for planning of radar stations and studies related to radio communication. Another important application will be in updating of the Economic Map database as mentioned above.

5. DIGITAL ORTHO PHOTOS

During the last year we have discussed the possibility to add digital ortho photos to the Economic Map database. NLS developed software for digital ortho photos already some seven years ago. However, at that time no user needs for digital ortho photos existed. Moreover we had no possibility to put out the ortho photos on film material.

Now the conditions have changed. We have acquired a Barco 3800 laser plotter which is very suitable for output of digital ortho photos on film. Moreover some important users have announced their interest in digital ortho photos.
NLS has recently carried out a pilot test with digital ortho photo map production. The test included the production of some 40 ortho photos. The production was based on scanning of aerial photo diapositives with a resolution of 25 microns. The digital ortho projection was carried out with an in-house developed software.
An important part of the pilot study was to make use of CD-R for delivery of the digital ortho photos. In order to reduce the amount of data the so called JPEG method was used to compress data. We found it possible to compress data by a factor 10 without loss of image quality. Thus a 50x50 cms digital ortho photo with a 0,1 mm pixel size could by compressed to some 2.5 Mbytes. This means that it is possible to store about 250 ortho photos on a compact disc. The pilot test showed it very simple to store the digital ortho photos on a CD-R by using a PC, special software and a CD-writer.
Thus, it now seems that the time has come to start a full scale production of digital ortho photo. As a matter of fact NLS has now decided to start a digital production line for ortho photos. The aim is to produce some 1000 ortho photo map sheets within the next 12 months.
NLS has recently presented to the Government the plans for the official mapping for the coming nine years. In this plan NLS suggested to supply ortho photos for the part of the country covered by the Economic Map by the year 2003. This means an annual production of some 1300 sheets. This idea has been well received by some of the present main users of GIS.

6. FINANCING

In Sweden national gerographic databases are not a free utility although they are produced by tax-payers money. However, data are not sold to the users. Instead data are licensed to the users, which have to pay a licence fee. The size of this fee depends on the character of the use of data.
A basic pre-requisite for the relatively rapid establishment of the Economic Map database is that it has been possible to make agreements with a number of users to pay license fees in advance. NLS is aiming at a 25% contribution from customers to the total costs for building the database. These costs will amount to approximately 100 million DM.
In order to manage the time schedule, we have also decided to stop publishing the printed Yellow Map. However, the idea is not to cease printing completely but to start publishing the Yellow Map series again as soon as the database is completed in 1997. Then the aim is to publish the map with a 12 year time interval, which means a doubled revision speed.

7. REFERENCES

Ottoson, L.: Establishment of a high Density Terrain Elevation Database in Sweden. ICA, Maryland 1978.

Jonasson, F. and Ottoson: The Economic Map of Sweden - a Land Use Map with an Aerial Photo Background. BuL 3/1974.