THE DIGITAL MAPPING PROCESS OF THE BASIC MAP OF FINLAND 1:10 000 / 1:20 000

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ABSTRACT:

The production of the Basic Map of Finland begun in 1947 and was completed in 1977. After that the revision was the main activity. Already in 1972 a digital testwork was started. After that more and more digital workphases were introduced into the production. We can summarize that in last 20 years in the National Board of Survey, Finland there has been a fortgoing development towards a fully digital map production.

When the cheap digital conversions of analog to analytical stereoplotters were taken in production in 1991, started the second phase of the digital production by capturing digital map data with these plotters. Today the final digital output is a plotter output. A digital map publishing system will be implemented in late 1992 or beginning 1993. The whole country (3730 map sheet) will be covered by digital map in 2005.

In developing the production of a digital Basic Map we have discovered that the digital data for producing only the printed map is not enough. We must take into account the use in many GIS-applications. Therefore the goal of development is now a Digital Terrain Data Base.

KEY WORDS: Cartographic, Digital Systems, Integrated System, Mapping, Map revision.

1. INTRODUCTION

1.1 The old Basic map

The Basic Map of Finland is produced by the National Land Survey of Finland. It is printed in scale 1:20 000 in five colours. The actual mapping scale is 1:10 000 in southern and middle parts of the country (3100 map sheets) and 1:20 000 in northern parts of the country (630 map sheets). The Basic Map includes all typical data contents of a topographic map at that scale: planimetry and place names (road network, agricultural areas, hydrography, built-up areas, land use, etc.), contour lines with 5-meter equidistance, and real estate- and administrative boundaries.

The total amount of map sheets is 3730 and the area of each is normally 10x10 sgkm. The production of the Basic Map was started in 1947 and completed in 1975 in the field. The last map sheet was printed in 1977. Some of the map sheets were already revised before that. Revision of the maps begun strongly after that and now all maps are revised approximately every 10 years.

When the map was made first time a lot of photointerpretation was needed and used in the fieldwork. The map was made using rectified paper copies of areal photographs in scale 1:10 000. The fligt altitude was 3600 meters and photoscale 1:31 000. Stereoplotters were mainly used to produce contour lines and only some details of planimetry. Therefore the accuracy of the map is mainly considered to be about +/- 10 meters.

1.2 Digital methods and development

Since the year 1972 computer aided methods have been developed in the Basic Map production. First step in the development was to use manual digitizing of field concepts and automatic flatbed plotters in order to get rid of drawing by hand.

Next step in the development process was the start of the digital Cadastral Boundary Map of Finland in 1982. It is a Boundary map with photogrammetrically measured boundary marks. The map scale is 1:5 000. It is made to supplement the digital Cadastre of Finland. Orthophoto is used in producing the map. The map will be completed in 1997.

Digital height information was needed to steer the orthoprojector and therefore started the manual digitizing of the contour lines of the Basic Map. The other purpose of this digitizing is to get an Elevation Model of the country also to other purposes. It is also needed to the digital production of a Topographic Map in scale 1:50 000. The project will be completed in 1992 and it is financed also by other organizations than the National Land Survey.

All the digital production is made by using MAAGIS-software (formerly FINGIS). This software is a product of the National Board of Survey. It enables direct data capture from stereomapping to the map data base. It is also used in other mapping purposes.

The technical development and the use of cheap conversion of old analog stereoinstruments to analytical made it possiple to start the planning of a digital nationwide stereomapping.

All digital information are not collected only for the needs of the Basic Map production. The Topographic Map of Finland (1:50 000) is produced by using digital information of the Basic Map. Today it is produced by digitizing the print originals of the Basic Map. The methods of

automatic generalization are developed for this purpose.

2. PRODUCTION ENVIRONMENT

2.1 Organizational environment

The basic mapping in Finland is made by the National Land Survey of Finland. It is led by the National Board of Survey, situaited in the capital Helsinki. A new organization was taken in use 1.9.1991.

The whole country is devided into 11 local Mapping and Data Service Divisions. They have each a Mapping Unit consisting of 15 to 25 persons. The Unit is responsible of basic mapping process from stereomapping via field checking to fair drawings in scale 1:10 000.

The National Board of Survey then takes the responsibility of diminishing the originals to scale 1:20 000, making the print originals, printing the map, archiving and delivering as well as coordinating the whole production. The budget of all Basic Map production is about 56 MiFIM (13.5 MiUS$) per year.

2.2 Equipment environment

Two accuracy types of of stereoinstruments are used:

1. for aerial triangulation and point densification (7 equipments)

-WILD BC 2 anal. pl. (4 equipm.)
-WILD BC 3 anal. pl. (2 -"-)
-KERN DSR anal. pl. (1 -"-)

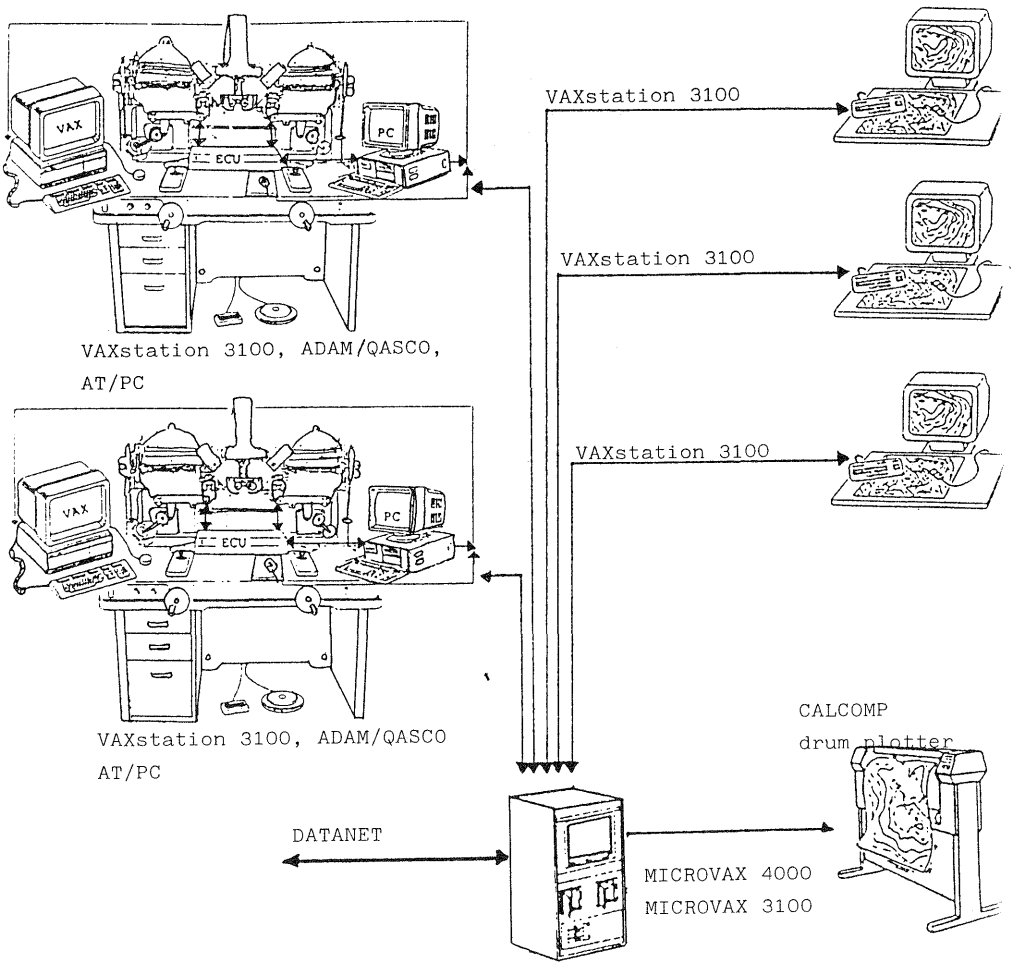
2. for stereomapping (18 equipments)

-WILD A8 with dig. encoders (8 equipm.)
-WILD B8 with ADAM analog-to-analytic conversion (6 equipm.)
-WILD B8 with QASCO analog-to-analytic conversion (1 equipm.)
-TOPOCART with ADAM analog-to-analytic conversion (1 equipm.)
-ADAM ASP2000 anal. plotter (1 equipm.)

In addition to the previous equipments we use in production: -drumplotters, CALCOMP
-digitizing tables, size A1, CALCOMP, ALTEK
-flatbedplotters, KONGSBERG
-electrostatic plotter, VERSATEK

The Mapping Units and National Board of Survey are connected with datanetwork. In figure 1. is shown the typical equipment environment of a Mapping Unit.

Figure 1.: A SCHEMA OF THE EQUIPMENT ENVIRONMENT OF A TYPICAL MAPPING UNIT



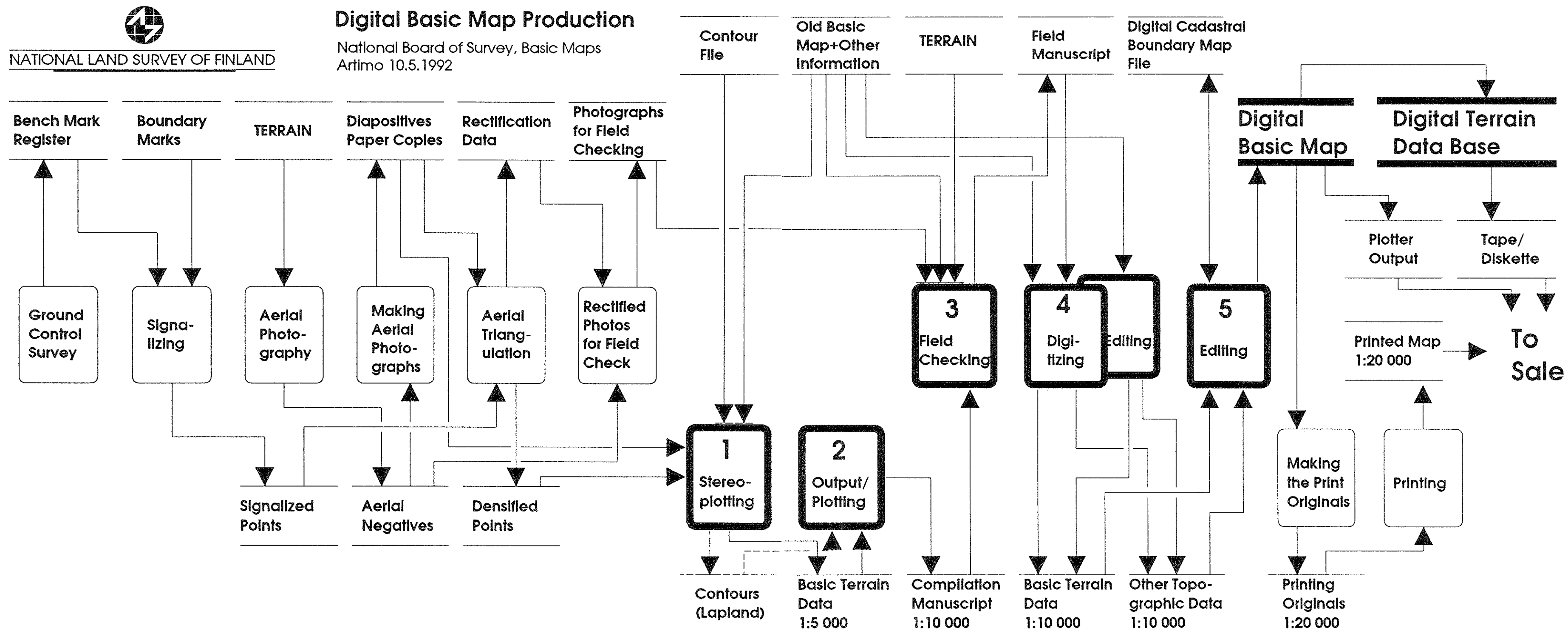


Figure 2
The Process of the Digital Basic Map Production

2.3 Production plan

The production has started in 1991 and today the scooling of the cartographers is active. In following the production plan shows the annual amount of map sheets.

Year	Map sheets
1991	43
1992	144
1993	195
1994	250
2003	340
2004	340
2005	340

The whole country will be totally covered by the Digital Basic Map in the year 2005.

3. THE PRODUCTION PROCESS

The entire process of the production of the Digital Basic Map is shown in figure 2. It starts with signalizing the Bench Marks and Boundary Marks to be used also in the production of the Digital Boundary Map. The aerial photographs are taken in scale 1:16 000 and a pancromatic film is used. Areal triangulation is used to produce both the ground control points and rectification data for paper copies.

In this presentation we emphasize ourselves more deeply in the digital parts of the production process, it means the steps marked by numbers 1...5 in the figure 2.

3.1 Stereoplotting

Stereoplotting is one of the most essential stages of the process. The source data consists of aerial photographs, the old graphical Basic Map and the digital Contour data. In stereointerpretation we interpret and plot only information which can easily and accurately be identified with the help of support infomation. The result of this is called the Basic Terrain Data and it consists of road network, hydrography, agricultural areas, buildings and built up areas, and high voltage network. The Contour data is added to this information. The accuracy is about +/- 1 meter. Stereointerpretation and plotting takes 15-30 working days per map sheet.

3.2 Plotting

The Compilation Manuscript is produced in scale 1:10 000 by a drumplotter.

3.3 Field checking

Field checking is made by using aerial photographs (rectified paper copies) in scale 1:10 000, copies of the Compilation Manuscript and copies of the old/existing Basic Map. Other relevant information is also used like other maps, different plans and so on. Information contents of all data are checked and the Basic Map is revised graphically. Especially the coding/classification of stereoplotted information is checked.

The result of this stage is called the Field Manuscript. It is a graphical drawing on the copies. It takes 5-10 working days to do the field checking per a map sheet.

3.4 Digitizing and editing

By using the Field Manuscript the Basic Terrain Data is updated and completed. This editing is made on the screen. At the same stage the revised information of the old Basic Map (which are not yet in digital form) e.g. rocks, marshes, other ereas, special areas, historical monuments, as well as place names are digitized manually on table. The result of this digitizing is the Other Topographic Data and the accuracy is +/- 10 meters. This stage takes 15-20 working days per map sheet.

3.5 Editing

The last stage of the production process today is editing and combining all digital data together. The Digital Cadastral Boundary Map (DCBM) file is combined with other data. The edited data is also brought back to DCBM file. Now we have all data of the Digital Basic Map in one file. This file can be plotted e.g. on drumplotter or flatbedplotter or it can be produced by an electrostatic plotter. Information can also be delivered in digital form (tapes, diskettes).

4. THE DIGITAL TERRAIN DATA BASE

4.1 Introduction

The previously described production process was made for only producing information required in the Basic Map production.

The digital map information could also be a widely used source data for many GIS-applications. Serious problems, however, occured in attempts to utilize digital map data. The information was really collected only for map production, not to be used e.g. in planning or analysis.

What was needed was a real data base oriented approach, where already in the data collection and registration stages the requirements of the users were taken into account.

4.2 Conceptual model

The Digital Terrain Data Base (DTBD) information is modified in several aspects. The DTDB definitions differ from Digital Basic Map definitions in:
-description of data objects
-data structures
-definitions of data quality
-data representation

By now a conceptual model has been described, consisting of ca. 400 data objects with definitions. Data quality as well as map representation has also been designed and defined. The models have been constructed inside the National Land Survey and they have been circulated among users in order to get comments.

4.3 Use of the Digital Terrain Data Base

The Terrain Data Base will be a large system when implemented and by now there are no specified plans on the software environment. The data base will be created and updated by the basic mapping activity. It will be utilized both in the production of the Basic Map and in the production of the Topographic Map 1:50 000 and in addition to these by several users from other organizations.

The maintenance is done partly with the revision of the Basic Map, which is not yet done. We are planning the revision every 5 years using stereoplotters with superimposition of data. It would be the revision of the Basic Terrain Data. Other data would be revised using data from different sources by editing the information in the DTDB.

5.DEVELOPMENT PLANS

The digital production process described in previous chapters goes on with manual printing process. The result today of this digital process is a plotter output.

More research and development work have to be done to check the capability of electrostatic plotters in making colour maps. Our opinion is that electrostatic plotters make good manuscripts but they cannot replace printed maps in accuracy and in visual quality.

Our future plan is to complete the digital production line by a map publishing system. The final selection is still in process and the goal is to have a digital printing production line in production in the next year. Our plan is also to put the finishing touch to the digital production and to the contents of the Digital Terrain Data Base in near future.