

N O R W A Y
N A T I O N A L R E P O R T

XIV CONGRESS OF THE INTERNATIONAL SOCIETY FOR PHOTOGRAMMETRY

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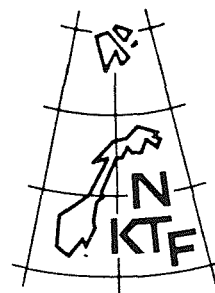
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The Norwegian Association for
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1 INTRODUCTION (Preface)

This report is produced by Norges Karttekniske Forbund, NKTF, The Norwegian Association for Cartography, Geodesy and Photogrammetry. NKTF is the Norwegian member of ISP.

The report gives a short introduction to the most important developments and changes during the 4year period 1976 - 1980.

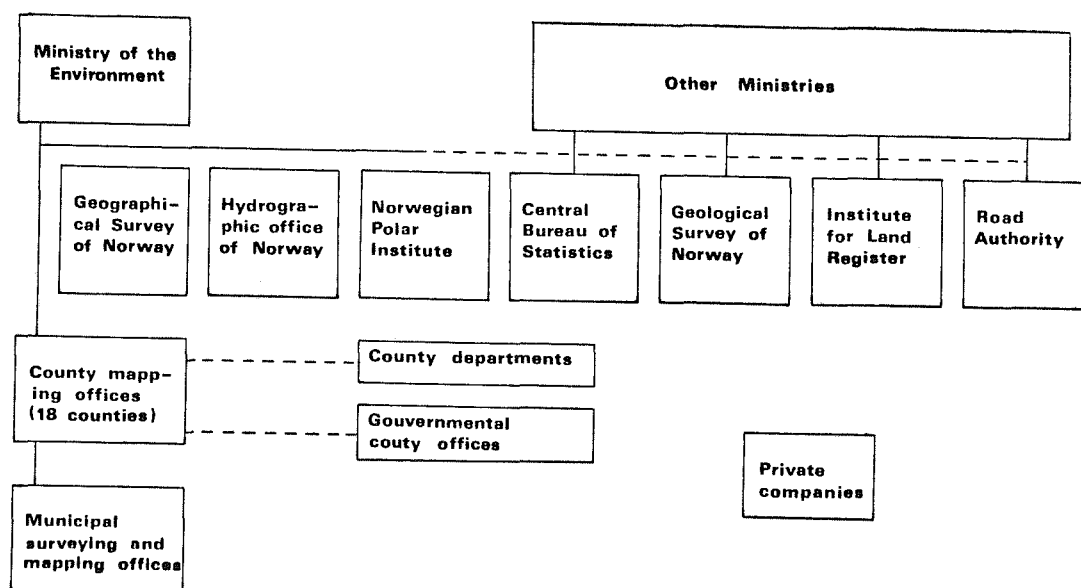
The most obvious changes can be seen in computer assisted photogrammetry and remote sensing.

The National plan of Mapping, part 1 "Maps and data" (Kart og data) which was issued in 1979, gives the general lines for activities in 1980's. The plan, which is very comprehensive, is the most important guide to future development in the branch.

The report also takes up, though in less detail, the status of photogrammetry in Norway today.

2 ORGANIZATION OF MAPPING AND CHARTING ACTIVITY

In Norway maps and charts are produced by a large number of state and local government authorities and institutions, private companies, scientific or other organizations and by private persons. The majority of the maps are produced and published by Central Government Institutions, while overall responsibility is in the hands of the Ministry of the Environment.



The most important departments and institutions involved in the administering of maps and other geographical located information.

The Ministry of the Environment coordinates aerial photography, remote sensing, mapping and production of other geographical located information. The Ministry is directly responsible for the administration of topographic mapping in the scale of 1:5.000 and less, nautical maps and for some registers, such as real estate register.

The Ministry is supported by a national surveying and mapping council.

Within the Ministry there are three professional departments responsible for map production:

- Geographical Survey of Norway is responsible for all basic geodetic surveying and for topographic mapping within Norway proper. The institution also produces thematic maps.
- Hydrographic Office of Norway is assigned the responsibility for nautical charting in Norwegian coastal waters and offshore areas.
- Norwegian Polar Institute is responsible for mapping and charting in arctic and antarctic regions, including nautical charting in these areas.

The County Mapping Office is responsible for the administrations of Mapping and charting activity within the county. It is also responsible for the production of the Economic Map-series in the scale 1:5.000/1:10.000 and to give input on property, addresses and buildings to a national register, GAB.

The Municipal surveying and mapping office's main responsibility, is production of maps in the scale of 1:500 - 1:2.000 and cadastral survey.

Other institutions producing maps can be divided into three main groups:

- Public institutions whose main activities are map production and registration of geographical located information for a number of registers. They distribute maps and informations to other users.
- Public institutions which produce maps for their own needs.
- Private companies engaged in aerial photography, mapping and surveying. These companies produce almost 100% of all maps in the scale of 1:20.000 and larger.

3 PUBLIC STUDIES, 1976 - 1980

The standard for the Economical Map series has been recently revised and was last published in November 1978.

A new standard for maps in the scales of 1:250, 1:500, 1:1.000 and 1:2.000 and municipal surveying, "Norm for kart i målestokkene 1:250, 1:500, 1:1.000 og 1:2.000 og kommunale oppmålingsarbeider", was published in January 1979.

On the 21st January 1977 the government decided to produce a National plan for mapping, "Norsk Kartplan". The plan should:

- Contain a short description of map and surveying activity, as well as the needs of the map users.
- Analyse where needs and the users value of the maps are considered against technological, economical and personell resources.
- Decide the priority of the various activities.
- Contain a complete plan of production adjusted to needs and possibilities. The plan shall give detailed information about amount of work, necessary capacity, schedules, technical solutions coordination, cost.
- Contain a financial plan, which takes into consideration the distribution of the work amongst the different organizations and between public and private institutions.

Part 1 of "Norsk kartplan" was presented to the Ministry of the Environment in December 1979, it is called "Maps and data", "Kart og data". It gives a proposal to coordinated production of aerial photography, topographic maps and some registers.

Work on the plan is continuing and will be presented in several reports, each report is designed to give action to new and better production series and products.

4 MAP-PRODUCTION IN NORWAY, 1976 - 1979

Only the main map series are included in the following.
(In addition, thematic maps and maps for other purposes, such as hydrogopic power plants, dambuilding, industrial site planning, forestry etc. are produced).

4.1 Topographic map of Norway - scale 1:50.000

The topographic map of Norway in the scale of 1:50.000 is planned to cover the whole country.

The table below gives a summary of the maps produced:

<u>Year</u>	<u>Number of map sheets</u>
1976	31
1977	25
1978	29
1979	40

Each sheet covers approx. 450 km².

By 1st January 1980, 470 sheets have been issued. The remaining 255 are planned to be completed by 1986.

4.2 Economic Map of Norway - scales 1:5.000 and 1:10.000

The Economic Map of Norway is planned to cover 177.500 km², which is approx. 57% of the total land area. 158.000 km² will be mapped in the scale of 1:5.000 and 19.500 in the scale of 1:10.000. The table below gives a summary of produced maps:

<u>Year</u>	<u>Area mapped</u>
1976	10.505 km ²
1977	8.191 "
1978	8.923 "
1979	7.127 "

By 1st January 1980, 119.877 km² had been mapped. The whole series is planned to be completed by 1985. Revision of the oldest maps has started.

4.3 Municipal maps - scale 1:500 - 1:2.000

Municipal maps are produced for local needs. The annual production within a community varies.

The average annual production for the whole of Norway has been approx.:

<u>Scale</u>	<u>Area mapped</u>
1:500	50 km ²
1:1.000	700 "
1:2.000/2.500	250 "

4.4 Orthophoto

No orthophoto-series exists in Norway, but a series combined with the Economic Map in the scales of 1:5.000 and 1:10.000, is planned.

Most orthophotos have been produced for forestry purposes in the above mentioned scales. The use of orthophoto has increased during the period.

The amount of production during the 4 year period has been calculated to approx. 3.000 km² in the scales of 1:5.000 and 1:10.000. There has been very little production in other scales.

5 RESEARCH AND DEVELOPMENT

There has been a great deal of activity on research and development, largely (computer) EDP-orientated.

This chapter deals firstly with some of the main projects, and then describes the development in equipment, instrumentation and methods, as well as development in research.

5.1 Projects

5.1.1 Mapres

The map automation projects MAPRES (maps and resources) was carried out from 1975 to 1978. The primary purpose of the project was to develop new tools for automatic map production. A secondary purpose was to extract, structure save numerical geographi data which is generated in map production, and make this available for government agencies in their management of natural resources.

The final product of the project is a set of programmes that operate on digital map information from stereoinstruments or digitizers.

The programmes are able to:

- automatically correct small inaccuracies in the input data.
- edit and draw maps, where scale, extent, use of symbols, grid orientation and contents of map are specified by the user.
- compute areas of different content.
- compute intersections between areas.

The project was a joint undertaking with three participants: The Norwegian Council for Scientific Industrial Research, Ministry of Environment, and the GEORES-group. The GEORES-group Consists of: Fjellanger Widerøe A/S, A/L Kommunedata, A/S Kongsberg Våpenfabrikk, Statex A/S and Norwegian Computing Center.

5.1.2 Testøk

As a part of the MAPRES-project, and with the spesific purpose of testing the developed MAPRES-software, TESTØK was completed during 1977.

TESTØK tested the suitability of the software with respect to the Economic Map series.

10 sheets were produced and the results indicated that, with the exception of countouring, it should be possible to get rentability with an automated production of Economic maps.

5.1.3 Map automation Nittedal 1978/79

In this project the MAPRES-software was used in regular production of Economic maps - scale 1:5.000.

The project was undertaken jointly by Fjellanger Widerøe A/S, The County Map Office for Oslo and Akershus, The Geographical Survey of Norway and The Norwegian Computing Center.

181 km² were mapped. All automatic drawing was carried out on a Kongsberg Dm 1216 system. The maps were corrected by hand.

Approximately 70% of the traditional manual fair drawing was automated. The cost was about 160 % of traditional manual fair drawing.

As a result of this, the software has been corrected and the amount of automation is expected to be raised to 90%.

5.1.4 "SOTRA" - project

This project tests the MAPRES-software for revision of Economic maps. It comprises 310 km².

The five main private companies each map their individual area.

5.1.5 IGS - Interactive graphic system

The Norwegian Computing Center has developed a prototype interactive graphic system in cooperation with The Geographical Survey of Norway. The system is designed as a tool in work with geographic located information, but it is also aimed at the MAPRES-system.

The prototype is working satisfactorily and will be developed to do more advances map editing.

5.1.6 Orthophoto and Digital Height Model

During 1979 - 80 a study giving detailed specifications for a modern off-line orthophoto production system, has been carried out. The products will be orthophoto + stereomate. They will be used in interpretation of soil, vegetation and property boundaries as well as for map revision. Proposal and specifications for a national digital height model is a part of the project.

5.1.7 Aerial Photography in Forestry

During the 4 year period, the use of aerial photography in Forestry has increased considerably. This is due to the increased needs of planning, better map and orthophoto coverage and increased cost of traditional methods. The use of photointerpretation has increased and volume calculation derived from tables based on photomeasurement has come into practical use.

At the Agricultural University of Norway development of a suitable type of forestry map is under way. The Norwegian Forest Research Institute is working on a project with the aim to develop methods for regional inventory, based on aerial photographs. Tests with supplementary aerial photography taken in strips with a 70 mm lens camera, as well as with wing-tip mounted cameras with fixed base, is going on.

5.2 Development

5.2.1 Aerial photography and remote sensing

Aerial photography for mapping purposes is carried out exclusively with Wild cameras, type RC 8 and RC 10. Standard focal length is 15 cm, but 8.8 cm, 21 cm and 30 cm lens cones are also available. The use of false colour infra-red film for vegetation mapping, often combined with simultaneous exposure of panchromatic: black-and white film, is increasing slowly.

Remote sensing is developing rapidly, mainly due to the specific interest of the following three institutions, The Geographical Survey of Norway, The Norwegian Water and Electricity Board and the Ministry of the Environment.

Norwegian Aerial Survey and Remote Sensing (Norsk Luftfoto og Fjernmåling I/S) and IBM-Norway are the two companies involved in producing Remote Sensing data, the former on the recording and scanning side, the latter on processing.

Terminated projects of interest, are mapping of vegetation on Svalbard (LANDSAT), research and development of methods for mapping snow cover for hydro electric power plants (TIROS), collection of oceanographic data for the North Sea (TIROS, SESAT) and a test of the scanner method, compared with multispectral photography. Preliminary reports indicate that the scanner methods yields more relevant information, while the use of multispectral photography has in general decreased considerably during the period.

The activity in 1980 - 81 will be orientated towards mapping in Polar regions, detection and classification of oil pollution in the North Sea, and in developing countries.

5.2.2 Photogrammetric plotting instruments

Analytical stereoplotters. The Zeiss Jena STEREODICOMAT shown in Helsinki 1976 as a prototype, was developed in Norway. The development has ceased, but the prototype was completed in 1976. Since then it has been used full time by a private company in Oslo.

The second analytical stereoplotter in Norway, a Zeiss Planicom C 113, was installed at the Land Reallotment Service at Ås in February 1980.

Analog stereoplotters. During the period, approx. 15 mechanical analog plotters have been acquired: Wild B8, A10, A8, AM, AMH, AMU, Zeiss Jena Topocart, Galileo Stereosimplex G6. There is a trend to equip existing plotters with closed loop TV-camera and advanced digitizing equipment. Some digitally controlled plotting tables (Wild TA) have been installed during the last two years.

Some of the maps are now being digitized during compilation in the plotter, and then fair drawn on Kongsberg DM 1216 drawing machines. This method is on the increase.

5.2.3 Aerial triangulation is applied for the determination of control-points for mapping in all scales from 1:5.000 to 1:50.000 (picture scale 1:15.000 to 1:45.000). For mapping in large scales, the control points are still mainly determined in the field. During the period, photogrammetric methods for ground control point densification have been used to some extent. The Stuttgart PAT-M 43 programmes have been installed. Adjustment by independent models is increasing, adjustment by polynomials is decreasing. Bundle adjustment is not regularly used.

5.2.4 Digitizing equipment The needs for flexible digitizers and computer support to analogue instruments in automated mapping (MAPRES), generated the development of the MAPDAT digitizing system. The MAPDAT digitizer is based on a microcomputer with suitable software. It is a joint development by VIAK A/S and SINTEF - The Research organization connected to the Technical University of Norway.

The computer support to analogue instruments has given room for new and more efficient sampling methods and numerical orientation aid for the stereo-operator.

5.2.5 Non-Topographic photogrammetry Private companies apply photogrammetry for architectural mapping, for determination of large caverns in rock, and for geometric control measurements of jackets for off-shore constructions.

5.3 Research

5.3.1 Technical University of Norway The Department of Photogrammetry and Geodesy has established a test field 3 x 3 km², in mountainous terrain for complete camera calibration under operational flight conditions. About 70 control points have been permanently signalized and measured in this field. Several calibration flights have already been carried out. At the same institute, a project is initiated to adapt analytical photogrammetry for making measurements of off-shore platforms during construction.

5.3.2 Agriculture University of Norway The main topics during the last four years have been:

- Signalization with various sizes and colours for different types of films.

- Coastal mapping in shallow waters with aerial photogrammetry
- Analytical plotter
- Usability of stereo-orthophotos.

5.3.3 The Continental Shelf Institute

Under water photography. Under water photographs from different parts of the Norwegian continental shelf have been used for geological classification of parts of the sea bed. Projects are going on in order to achieve optimal utilization of stereo pairs for inspection of constructions, for mapping of small areas at great depths and for geological classification by Fourier analysis of height profiles.

SEAMAP research program. A research program has recently been initiated for development of technology for topographical mapping of the sea bed. The optical hydrography part covers under water photogrammetry, remote sensing for aircraft and satellites, including aerial photogrammetry, and laser hydrography.

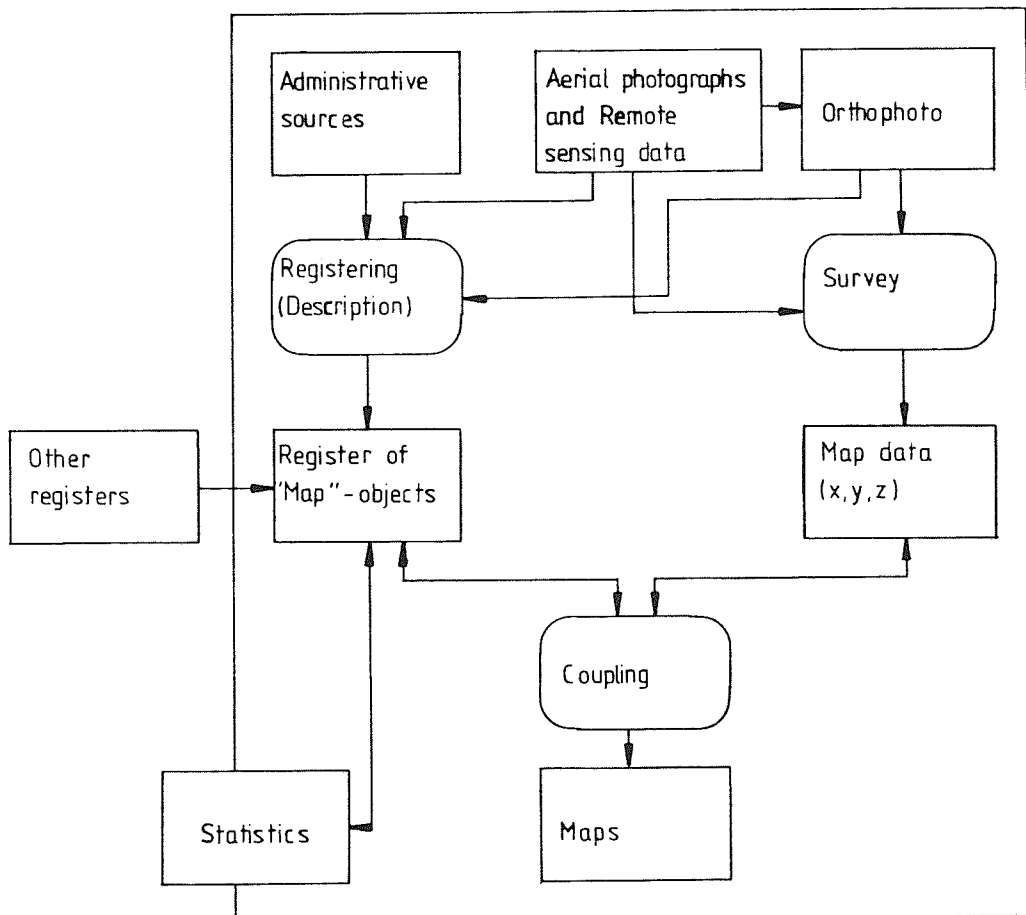
6 EDUCATION

Education at technician level (photogrammetric operators), is given at the "Rud vocational school". This school offers the opportunity for up to two years training in survey subjects, including some 120 hours of theory and 200 - 400 hours of practical training in photogrammetry. Four students complete this course every year. In addition, there exists some institutional training schemes at the map production organizations.

At engineer level, no courses in photogrammetry exist.

At university level, photogrammetry is taught at two universities, The Technical University of Norway (NTH, Trondheim) and the Agricultural University of Norway (NLH, Ås). The courses last for 4 - 5 years. Each year, 6 - 8 student take their Master's Degree in photogrammetry, cartography or geodesy.

Geographical located information is available today in the form of maps, orthophotos, registers and statistics. In "Norsk Kartplan" a model is planned with the aim to tie these products closer together and to improve the communication between the various types of information. Improvement in datacollection is also included.



The system is designed to give the individual user a faster and simpler way to obtain all available relevant information. The whole system is EDP-dependent and is aimed at obtaining the maximum from new techniques.

Updating and revision of the system will be carried out in two ways:

1. Continuous reports to the registers
2. Periodical aerial photography covering the whole country. A 10-year revision cycle is planned.

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