

TRENDS IN COMPUTER-ASSISTED CARTOGRAPHY IN HUNGARY AND EASTERN EUROPE

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INTRODUCTION

The situation in Eastern Europe on the field of computer-assisted cartography has so far been different from that in advanced countries of Western Europe. The activity in the theoretical domain is very extensive. Technical equipment of computer-assisted cartography and its spreading of use for geographical and cartographical systems in the society is, however, rather low at present. The main reason for this situation is a non-adequate level of hardware, lack of specialized equipment for displaying graphics and for processing image information.

After this short review I should like to introduce to the conference the current state and trends of computer-assisted cartography and GIS in Hungary and Eastern Europe ending with the activity of a quasi committee of COMECON on the field of computer-assisted cartography. The paper describes the Hungarian situation and selected information from Czechoslovakia, Poland and the USSR.

COMPUTER-ASSISTED CARTOGRAPHY AND GIS IN HUNGARY AND SOME EASTERN EUROPEAN COUNTRIES

Trends in Hungary

The activity of the community of Hungarian scientists involved in research and development in computer-assisted cartography covers a wide range of fields in accordance with the distribution of interest and funding.

As regards the data acquisition system, different interactive vector digitizing systems can only be mentioned, where software has been worked out in house. In addition, some experimental studies are under way related to automatic data collection, such as raster scanning maps and digitizing of stereomodels. Unfortunately, up-to-now there are not any line following or automatic digitizing systems for large format in Hungary.

Preliminary results of research concerning interactive data editing can be attributed, for the most part, to engineers due to the influence of CAD/CAM. In the mapping were born some useful results with a GRADIS system in a DEC environment and in PC type IBM AT/XT with own software.

In a cooperative research project techniques for the processing of digital elevation data have been developed. DEM's can be constructed, and are reported to be effective in automatic determination of relief features that can be useful in different methods of relief representation, and

in other branches of thematic application, e.g. land evaluation, micro-wave propagation, remote sensing, in mapping of geomorphology, erosion etc.

Due to the relatively rapid spread and development of the remote sensing centre of the Institute of Geodesy, Cartography and Remote Sensing, there is a constant stimulus for production and updating of land-use/land-cover maps. /There are no such standard maps in Hungary./

Based on LANDSAT Multi-Spectral Scanner and Thematic Mapper technology is being developed for natural resource assessment and the monitoring of land-use changes in agricultural areas first /appr. 70% of the country/. Classification methods have been tested for the verification of attribute data of the 200 meter resolution national digital terrain model of the country. The potential of the high resolution digital SPOT imagery, as opposed to traditional metric aerial photography, is presently under thorough investigation. Although Hungary is well covered with 1: 10,000 and even larger scale base maps, for historical reasons there are several data bases without a common geometric reference. The introduction of the Unified National Mapping System, however, facilitated the development of compatible, geocoded digital cartographic data bases.

There are thorough developments in some topographic data bases. First of all I mention the National Topographic Data Base for large scale of 1: 1,000 to 1: 4,000. This system has been used to complete two test areas for large towns, e.g. Szeged and Budapest to assist in the establishment of national digital cartographic data standards.

In addition to the previously mentioned data base, the development of the National Elevation Data Base at a scale of 1: 10,000 is being carried out with digitizing of horizontals.

Additionally, the Institute of Geodesy, Cartography and Remote Sensing led the design and implementation of the topographic data base containing 60,000 geographic names for all 19 Hungarian counties. The Institute of Geodesy, Cartography and Remote Sensing, along with Cartographia Enterprise, also took part in the development of the Cartographic Thesaurus; a non-spatial data base of approximately 30,000 thematic maps, an aid for compilation and production purposes. Numerous research efforts can be recognized as several users satisfy their specific needs from agriculture, regional planning, and industry. Nevertheless, most of these systems are not true GIS's, but serve as information systems for decision making with cartographic tools included.

The appearance of more distributed, PC-based systems improves the opportunity for cartographers to develop GIS technology for both local and national levels, e.g. at the Scientific Institute for Regional Planning, and the Research Institute for Soil Science. The Hungarian Soil Information System applies the geo-reference system of the Unified National Mapping System for all point, line and

and polygon data, with the development of multi-colour /i.e. non-binary/ quadtree techniques in a GIS environment, with input, data base management, query, and output subsystems. The system is being developed for Pest County.

Reliable and efficient information collection on the major crops in Hungary is of vital importance both at the decision making level of the Ministry of Agriculture and Food and at the level of farms too. Satellite remote sensing seems to be adequate to this task. A satellite based geographic information system for agriculture has been worked out in Hajdú-Bihar County. A complex processing system, REFER /System for Regional Inventory and Modelling of Natural Resources/ is introduced together with the role of its subsystems in data processing. This system is based on raster and vector subsystems. GIS's and semi-GIS's developed in the last couple of years in Hungary may be classified by the following groups: information systems for geodetic and cartographic purposes, town information systems, information systems for regional planning, information systems for different thematic and statistics analysis, information systems for CAD/CAM aims, decision making information systems mainly in Hungary in the interest of environmental protection.

In addition to the previously mentioned research and development that involves several aspects of data manipulation /e.g. remote sensing and DTM's/, some "Traditional" research concerning generalization using filtering and classification rules for choropleth maps are carried out at the Department of Cartography, Eötvös Loránd University of Sciences. Basic research was conducted for the application of spatial statistics in mapping natural phenomena.

Trends in Czechoslovakia

The development of computer cartography takes place within the framework of the state governed Department of Geodesy and Cartography, at the Universities J.E. Purkyne in Brno and I.A. Comenius in Bratislava, the Technical Universities in Prague and Bratislava, as well as at the Institute of Geography, Czechoslovak Academy of Sciences in Brno, and within the framework of numerous design offices. Verified technologies of cartographic production are centered primarily on the field of large scale cartography and on medium and small scale thematic map production.

The Department of Geodesy and Cartography develops the information system of geodesy and cartography with three fundamental subsystems. These are: -SIG, information about geodetic points; -REN, real estate information; -SLI, localization information.

The third one is the most important as it serves the automated production of state mapping work for basic large scale maps /1: 1,000, 1: 2,000 and 1: 5,000/. The -SLI subsystem represents essentially a digital map of selected localities stored on large capacity disks.

Thematic map production is coordinated by the Institute of Geography of the Czechoslovak Academy of Sciences, which is equipped with the DIGIKART graphic system of Czechoslovak production. Its components are: Digipos for semi-automatic digitizing, ADT computer and Digigraph. The most significant example of the production of thematic maps is the Czechoslovak Population Atlas and Atlas of the 1980 census of the Czech Socialist Republic, both developed by means of automated technologies. Automated technologies for thematic maps are also developed by regional institutes and universities. The system of data acquisition, encoding and storage is governed by policy and by the automation techniques available /system includes for instance GRADIS/.

A data base of a basic large scale map of the CSSR was developed; its fundamental entity is an object of the type "point, line and area". Every object is described by a classifier, a coordinate list and the drafting specifications. Attributes include information about the connections of particular points, the type of line, its thickness and the type of the point symbol according to the symbol key.

A number of computer graphics systems of both foreign and home provenance are used. Among the foreign systems the products of the firms CONTRAVES and KONGSBERG are predominant. Czechoslovak production is represented by the digitizers DIGIPOS and DGZ, the plotting tablets DIGIGRAF, AGS 4500, with the control computer ADT and the ISAP system with the SMEP computer are produced serially. The program language is mostly Fortran and PL/1, the graphics software is SFC, GFS and GRAFOS. The predominating systems are DOS-3 and DOS-4.

Trends in Poland

Geographic Information Systems are one of the most rapidly developing areas of geosciences in Poland. The progress in this field can be described with three kinds of activity. The first group includes the creation of universal tools for constructing GIS. Some theoretical and conceptual work belong to this group. The second direction is the elaboration of subject-oriented GIS for specific professional branches. The third one is based on application of ready commercial GIS for specific purposes.

In the Geodetic and Cartographic Data Processing Institute /now in the Institute of Geodesy and Cartography/ a geographical information system of universal purpose, based on regular grid, is being elaborated. They deal with data models, data base structures, modular spatial analyses, cartographic display and methods of data acquisition as well as of implementation based on elaboration of algorithms and programmes.

The representatives of the second direction of GIS development are the systems BIGLEB, elaborated by the Polish Soil Sciences Society and PROMEL, developed by the Irrigation Design Bureau. Both systems allow the collection of various data about soils, hydrology, elevation, crops etc. in a regular grid based on geographic coordinates. Captured data

are analyzed and processed for the purpose of spatial planning and designing.

The same direction of activities includes the project for the Land Information System /LIS/ of Poland elaborated at the Geodetic and Cartographic Data Processing Institute. It is based on multipurpose cadastre and digital base maps. The LIS will have many connections with branch information systems and will serve mainly administrative authorities on several levels.

One of the important tasks of GIS data base is the topographic information. In 1987, the concept of digital topographic map was prepared at the Geodetic and Cartographic Data Processing Institute. The concept took into account computer-assisted topographic mapping processes as well as supplying any GIS with topographic information.

Examples for the third kind of GIS projects may include the ERDAS system application for remotely sensed data processing at the Institute of Geodesy and Cartography. The implementation of ARC INFO system for environment protection projects is also planned.

The computer market in Poland is full of personal computers, and this is why they plan to create one option of geographical information systems for that kind of equipment. 32-bit personal computers with high capacity disks are sufficient for a series of applications, but systems to cover the territory of the country demands larger computers. For research work they use MicroVAX II computer, which could be exploited for one of the operational geographical information systems. The above mentioned systems, BIGLEB and PROMEL were implemented on Polish made ODRA minicomputers. There is no hardware oriented geographical information system like INTERGRAPH installed in Poland. The equipment they use consists of foreign and Polish digitizers like CODIMAT of Contraves /Switzerland/, or KARTOMETR of PCO /Poland/; plotters of Contraves /COROGRAPH DC2/, Hewlett-Packard /Draft Pro, HP 7585/, Roland /990/, IBM-compatible personal computers and MicroVAX II with 9 Mbyte memory and 491 Mbyte hard disk. For GIS project purposes they combine several of the mentioned devices to establish one compatible configuration.

Trends in the USSR

In the USSR we have witnessed an abrupt increase in the computer-assisted cartography and GIS; I will give you now some examples of some research centers at least.

A factual orientation of the research will be documented on the example of the Institute of Geography, Academy of Sciences, which is the centre for developing automated cartography and geoprocessing: elaboration of the conceptual framework of methodology and program software of geographical-cartographical modelling with utilizing numerical and logical and digital methods and geo-informational techniques, and at last but not least, elaboration of the theory and methods of global atlas mapping, including the digi-

tal expression of cartographic information and the experiment with forming banks of global cartographic data.

Up to the year 2000, the elaboration of methods of computer cartographic simulation is planned, the experiments with utilization of the GIS in modelling mutual relations and changes in territorial structures of the geosystems, cartographical data bases of local, regional and global levels.

From other centres where GIS of automated cartographical systems are developed, let me mention the Geographic Faculty of Moscow State University, where different advanced systems are oriented to the needs of thematic mapping. The technical framework consists of computers VAX, MITRA, the graphical display Radians 320, the digitizer and digigraph Benson, further they have a colour flat bed plotter. The supplied mathematical system is Grafiksi, specially created at the workplace for the needs of thematic mapping. A parcel of programmes is intended for preparing data including digitizing of cartographical materials, for revealing errors, for managing /their storage and removal for the processing/, logical-mathematical-statistical analysis, spatial approximations of regular and irregular networks, cartometric operations, constructing the system of cartographic signature. The aim of this system is to complete various maps for Moscow region, for schools and universities.

At the Faculty of Geography of Kazan' GIS is being developed for environment protection. It is intended for the observation, analysis and synthesis of complex geographical objects with acquiring forecasts. The system works on Soviet made hardware.

Very active in the development of GIS are the Baltic republics; it is right to speak about Estonian school of geo-information.

At "Kartografija" a project is being developed for an automated system of small scale map production. It is an information-technological man-machine system including all software and hardware elements for input, edit and output of 1:2,5 million scale map sheets covering the whole USSR. To mention the last example of the many systems developed in the USSR is the the GIS elaborated since 1981 at the Pacific Institute of Geography, Academy of Sciences, in Vladivostok. In 1986 the principles of compilation of the GIS for utilization of the environment were elaborated. In addition to numerous practical examples of its utilization, the following results were obtained: a computer atlas of temporal-spatial variability of agricultural production in the south of Far East has been compiled and issued, as well a series of computer-assisted maps of the dynamics for different thematic purposes. The system is being further developed taking into account the utilization of remote sensing and the methodology of processing dynamic images.

There were only few examples from the activity of Soviet computer-assisted cartography and GIS's.

COMECON COMMITTEE ON COMPUTER-ASSISTED CARTOGRAPHY

The work of the geodetic services of socialist countries is supported by the activity of special committees on cooperation in science and technology. These committees have been active for several years in increasing the effectiveness of scientific-technological development in the field of geodesy and cartography. The major topics include geodetic networks, remote sensing, complete automation of map-making, engineering geodesy etc.

The development of partial processes in the automation of large- and small-scale maps making was the primary importance in the field of map production automation.

New results in large-scale map production were mainly achieved in the development of automated data collection /both on the field measures and photogrammetric methods/ and interactive digitizing methods, and in the standardization of the requirements systems of large-scale maps automation.

Progress has been achieved in the automation of small-scale maps production: the standardization of the content of the cartographic thesaurus, and the automated preparation of the 1: 2,5 million world map.

In the forthcoming period larger effort will be laid on the automation of medium-scale or topographic maps. In this field the main purpose is the development of all hardware and software related to complex map production. The hardware components include the Czechoslovak digitizer, the computer and its peripheries made by the GDR, interactive work station, the Hungarian laser plotter etc. The system is of module configuration and it ensures both raster and vector processing of information, and it is also in accordance with the map standards of the COMECON.

The advantages of cooperation will only be remarkable in the long run.

SUMMARY

After the short description of the achievements in cartographic automation and geographic information systems in Hungary and in some of the Eastern European countries, the main trends are summarized as follows:

1. An increased demand for cartographic automation and GIS is recognizable in the countries of Eastern Europe.
2. Research, development and implementation are primarily carried out by their central authorities of cartography and geodesy, the enterprises and research institutes, but an important role can be attributed to the research institutes of academies and various ministries, and the technical development programmes of ministries.
3. The main directions of development are determined by the achievements of advanced industrialized countries known

through professional publications and conferences.

4. The automation of large-scale maps production is almost completed in most of the countries; and the same applies to some types of small-scale maps; the general situation is that only some of the partial processes are now automated, like in the case of medium-scale or topographic maps production; the common effort to automatize the preparation and revision of this category of maps has only just started on a conceptual level with COMECON hardware and software.

5. The countries concentrate large state resources and efforts on the development of various cartographic information systems /data bases/, but they are still rather in the state of development, experiment and research, and are not uniform and complete systems for the whole country.

6. As for the spatial or geographical information systems, they are produced in large number, they correspond to the centralized structure, but their vertical construction is usually incomplete. General purpose GIS's are becoming popular /e.g. ARC INFO, ERDAS/.

7. Western products dominate in hardwares /except computers/, though the countries have also started to produce hardware for cartographic purpose /Poland manufactures digitizers, the GDR produces interactive devices, Hungary has laser raster plotter etc./. Unfortunately, the level of raster input and output instruments production is rather lower at present. Their purchase is hindered by embargo.

8. The software development is largely influenced by the availability of abundant labour force /a cheap manware/; this is manifested in several and various kinds of GIS development projects. It often happens that the products are not compatible, which is explained by the fact that the commercial market in these countries is in fact missing. The same applies to the production of hardwares as well. In Hungarian-Polish relation various PC's are widely used; their software development for cartographic purpose is also advanced.