14th Congress of the International Society for Photogrammetry
Hamburg 1980
Commission IV, Working Group 1

Invited Paper

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U.S.A.

STATUS OF SOFTWARE IN DIGITAL MAPPING

ABSTRACT

A survey of existing activities in software for digital mapping was conducted among mapping organizations around the world. Results of the survey are compiled and analyzed with the objective of detecting evolving trends for automating cartography. A current and up-to-date status of organizational objectives in the general field of digital mapping is reflected. Issues facing designers of digital mapping systems are outlined for examination.

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A survey of existing activities in software for digital mapping was conducted among mapping organizations around the world. Results of the survey are compiled and analyzed with the objective of detecting evolving trends for automating cartography. A current and up-to-date status of organizational objectives in the general field of digital mapping is reflected. Issues facing designers of digital mapping systems are outlined for examination.

Introduction

Attempts to automate various aspects of the cartographic process have never ceased since the accelerated use of electronic computers started more than two decades ago. Early attempts of automation retained the line map as their final and only objective, therefore maintaining the same objective as traditional cartography. In pursuing this goal, components of the automation process were designed and built to emulate corresponding ones in the traditional mapping process. Except in some limited cases dealing with large-scale mapping, this approach has never been proven to be cost effective when compared with traditional cartographic production methods.

Continued growth in requirements for cartographic information in machine processable form is rapidly influencing the course of development in digital mapping. Digital cartographic files which have potential usability in many applications (including the creation of cartographic maps) are presently recognized to be the primary product of digital cartography.

An international survey of software for digital mapping was believed to be the most effective means for an accurate gauging of the evolutionary process that is taking place in the field. Understanding the general philosophy for cartographic automation around the globe is the primary objective of this survey.

Scope of the survey

The survey was addressed to 71 mapping organizations representing 53 different countries. It was mailed during November 1979 with a request for response by the end of January 1980. Responses were received from 17 organizations and varied from one page to almost 100 pages in length. An outline of the information requested for reporting was included in the survey letter. Adherence to this information outline was not universal which made it necessary to make some interpretations from the reported material. Lack of time prevented verification of these interpretations with the reporting organization.

The primary target of the survey was operational production-type software. Therefore, a random sample of national mapping organizations with significant production responsibilities was approached. It was felt that the probability of finding fully operational systems at these organizations would be the highest. Limited space allows for only a brief description of the main characteristics of the reported system. Responses were compiled under nine separate headings:

1. Organization
   Name and address of reporting organization.
2. System Classes
   Software is classified as dealing with digital line graphs, digital elevation models, or both.
3. Resources
   A list of hardware and software required to support the reported systems. For I/O devices, only those with graphics capability were reported. Computer peripherals such as line printers, card readers, magnetic tape drives, disk drives, etc., were not included.
4. General Functions
   A statement describing the software's general function.
5. Products
   Primary output of the process(es).
6. Subsystems
   Brief descriptions of major components for reported software.
7. Current Operating Mode
   Production, development, or some combination of both.
8. Programing Language
9. Sources
   In-house development, vendor, or developed under contract.

It is realized that the reporting format is too brief to provide more than a general view of the software systems. Parties who are interested in more detail are encouraged to contact the pertinent reporting organization.

AUSTRALIA

1. ORGANIZATION: Central Mapping Authority
   Panorama Avenue
   Bathurst
   N.S.W. 2795
   Australia

2. SYSTEM CLASS: Digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: Calcomp 748 flatbed plotter
   Processor: PDP 11/10
   Software:
   RSX 11M
4. GENERAL FUNCTIONS:
   The system collects string contour data from stereoplotters, allows data editing, and produces scribed contour sheets for large-scale mapping series.
5. PRODUCTS: Digital files and derivative graphics
6. SUBSYSTEMS:
   Currently the system is running in a limited operation mode. Plans are underway for upgrading the hardware and software capabilities.
7. CURRENT OPERATING MODE: The system is in production mode.
8. PROGRAMING LANGUAGES: The software is written 70 percent in DEC Assembler and 30 percent in FORTRAN.
9. SOURCE: All development has been carried out in-house.

AUSTRALIA

1. ORGANIZATION: Department of National Development & Energy
   Division of National Mapping
   P.O. Box 548
   Queanbeyan 2620
   Australia

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
   Hardware:
   I/O devices: (Not available)
   Processor: PDP 11/40
   Software:
   RSX11M and RSX11D DOS
4. GENERAL FUNCTIONS:
   The system is designed primarily for mapping of census boundaries. The digitizer-issued data, in geographic coordinates of census boundary segments, are collected, verified, and stored on random access disk files. The system also provides the capability to plot, on various map projections, a specified part of the census-boundary segments file.
5. PRODUCTS: Digital files
6. SUBSYSTEMS:
   The system has the following major subsystems:
   CENBDY is an interactive program to run a string or table digitizer to record, in geographic coordinates, the boundary segments (between nodes) of census boundaries and store them on random access files.
   PLOTER program is used to plot on various map projections a specified part of the census boundary segments file.
   PIEMAP plots proportional or classed piecharts on map projections from center point data and statistics.
   SHADER is used to shade census or statistical polygons in various map projections.
7. CURRENT OPERATING MODE: The system is in production mode.
8. PROGRAMING LANGUAGES: The production software has been written in FORTRAN language with some use of Assembler language.
9. SOURCE: All production software is in-house development.

BELGIUM

1. ORGANIZATION: Institut Geographique National (NGI)
   Abbaye de la Cambre 13
   1050 Brussels
   Belgium

2. SYSTEM CLASSES: Digital elevation model, digital line graph
3. RESOURCES:
   Hardware:
   I/O devices: Bendix-DataGrid digitizer
   CVD digitizer
   Calcomp (1136-936) drumplotter
   Processors: IBM 370/158 (batch)
   CGP-100
   Software:
   Calcomp Basic Software
   Graphic Interactive System (GIS)
4. GENERAL FUNCTIONS:
   The digital mapping efforts consist of collecting data from field measurements, photogrammetric records, and digitization of existing documents. The data base management is under the control of IMS-DB system of IBM.
5. PRODUCTS:
   Digital cartographic files and graphics displaying their contents
6. SUBSYSTEMS:
   Altimetry project: The aim of this system is to build digital files of terrain elevation data collected from field measurements, photogrammetric records, and digitizing existing maps. This information may result from discrete points, regular grids, or contour lines. The system builds and stores the contour lines from these terrain models. The system has the capabilities of selective inquiry and displaying elevation data as contour lines, perspective view, or listing.
   Automatic digitizing project: The aim of this system is to collect base map data through a scanner and to vectorize these data to allow corrections before loading the data bases.
   Small scale mapping project: This is a semiautomatic system used for registration and processing of small scale maps with partial automatic symbolic drawings.
7. CURRENT OPERATING MODE:
   Project Altimetry: In production mode.
   Project Automatic Digitizing: Vectorization program is under test presently; structuring programs and procedures are under study.
   Project small scale mapping: In production mode with further developments.
8. PROGRAMING LANGUAGE:
   All application programs are written in PL/I.
9. SOURCE: Except for GIS and Calcomp basic software, all programs are in-house effort.

BRAZIL

1. ORGANIZATION: Directoria de Electronica e Protecao ao Voa
   Divisao de Cartografia e Informacoes Aeronauticas
   Aeroporto Santos Dumont
   Rio de Janeiro
   Brazil 20021

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
   Hardware:
   I/O devices: Calcomp (925/748) plotter
   Processor: IBM 360/40
   Software:
   IBM 360 DOS
4. GENERAL FUNCTIONS:
   a) To collect and correct flight information data.
   b) To generate and plot Radio Navigation Charts in digital form.
5. PRODUCTS: Digital files and derivative graphics
6. SUBSYSTEMS:
   The system is a limited operation effort and consists of three programs:
   a) Program to input query data to the system.
   b) Program to chart correct flight chart.
   c) Program to plot the flight chart.
7. CURRENT OPERATING MODE: The system is in final phase of testing.
8. PROGRAMING LANGUAGES: The production software is written in COBOL and FORTRAN.
9. SOURCE: The system was developed under contract.

CANADA

1. ORGANIZATION: Department of Energy, Mines & Resources
   Surveys and Mapping Branch
   Ottawa, Ontario K1A 0E9
   Canada

2. SYSTEM CLASSES: Digital line graph system, digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: Gradicon digitizer
   Altek digitizer
   Calcomp Pen Plotter
   Processors: PDP 11/70
   PDP 10
   Software:
   RSX 11M Operating system
   XCM (PDP 10 Cartographic Monitor)
   Interactive Graphics Design System (IGDS-7)
4. GENERAL FUNCTIONS:
   The data acquisition system includes acceptance of digital data issued from the following sources:
   a) Manual digitization
   b) Direct digitization on stereoplotters
   c) Gestalt Photomapper
   The system includes interactive and batch processing capabilities for such general operations as collection, editing, maintenance, management, and display of cartographic data. The ultimate objectives are the production of national topographic maps and the digital terrain model applications in topographic mapping.
5. PRODUCTS: Digital cartographic files and derivative graphics
6. SUBSYSTEMS:
   1. The Interactive Graphics Design System (IGDS-7) is used for collection, display, maintenance, and management of digital cartographic data related to the production of national topographic maps.
   2. The Digital Terrain Model Post-processing System is designed to maintain and display digital terrain model data produced by Gestalt Photomapper (GPM-II).
   3. PDP 10 Cartographic Monitor (XCM) is used for collection, maintenance, management, and display of cartographic data.
7. CURRENT OPERATING MODE: All systems are in production mode.
8. PROGRAMING LANGUAGES: The software is written in FORTRAN IV and Assembler languages.
9. SOURCE: Interactive Graphics Design System (IGDS-7) was acquired from vendors. The Digital Terrain Model Post-processing System is an in-house development. PDP-10 Cartographic Monitor (XCM) is a combined in-house and contractor development.

FEDERAL REPUBLIC OF GERMANY

1. ORGANIZATION: Institut for Angewandte Geodasie
   Richard-Strauss-Allee 11
   6000 Frankfurt am Main - 70
   Federal Republic of Germany

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
   Hardware:
   I/O devices: ARISTO ARISTOGRID digitizer
   ARISTO ARISTOMAT 205 S plotter
   VERSATEC Printer-plotter
   CONTRAVES CODIMAT B digitizer
   CONTRAVES CORAGRAPH 1700 plotter
   Tektronix 4014 storage tube
   Tektronix graphics tablet
   Processors: DEC PDP 11/35, PDP 11/45
   Telefunken TR 440
   Software:
   Digital Equipment (DEC) RSX 11M3 O/S
   Telefunken TR 440 BS 3
4. GENERAL FUNCTIONS:
   The system controls all phases of digital mapping, e.g., collection of digital data, editing and maintenance of data files, data management mechanism and display of maps.
5. PRODUCTS: Magnetic tapes
6. SUBSYSTEMS:
   TRAFO: The system is used for mass transformation of coordinates in UTM, Gauss-Kruger, Mercator Conformal Conical (Lambert) and geographic coordinates systems.
   GENER, GENER1, GENER2: The systems are used for line-smoothing of lines consisting of chains of coordinates of points which have to be connected by a curve or by a straight line.
   VEKIRA: The system is used to convert data in vector format (chain of points) into a raster format which can be displayed on a VERSATEC printer-plotter or a Tektronix 4014 display unit.
   CD400: The system is used for interactive manipulation of cartographic data including such functions as collection, maintenance, display, and management of data.
   CIPS: This is another system for interactive manipulation of cartographic data.
   DATAS: This system performs data management and data editing operations on cartographic data files. The system can be used in interactive or batch mode.
   GEONET: The system is used for transformation of geographical coordinates into different map projections and for their graphical presentation on graphic output devices.
7. CURRENT OPERATING MODE: The subsystems are at various levels of development-production combinations.
8. PROGRAMING LANGUAGES: Most of the software is written in FORTRAN language. Some subsystems partly use Assembler language.
9. SOURCE: In general, the software is in-house development. Vendor software is used for specific purposes.

FEDERAL REPUBLIC OF GERMANY

1. ORGANIZATION: Land Register Surveying & Topographic Mapping Admin.
   Niedersachsisches Landesverwaltungsamt
   Abt. Landesvermessung
   Warmbuchenkamp 2
   D - 3000 HANNOVER 1
   Federal Republic of Germany

2. SYSTEM CLASSES: Digital elevation model, digital line graph
3. RESOURCES:
   Hardware:
   I/O devices: Digitizer
   Interactive graphic display
   CORAGRAPH DC 3 (CONTRAVES) flatbed plotter
   Processors: SIEMENS 7730 (BS 2000), PDP 11/45
   Software:
   Various software packages described below
4. GENERAL FUNCTIONS:
   Interactive and batch generation, editing, management, and display of digital line graph and terrain model data.
5. PRODUCTS: Digital cartographic files and derivative graphics
6. SUBSYSTEMS:
   1. The systems (IGS & LIK) for design of cadastral maps at the scale of 1:1,000 and 1:2,000.
   2. The system (AZP) for drawing the production of cadastral maps and other cartographic drawings.
   3. The system (CIPS) for interactive processing of topographic and thematic maps at the scales of 1:25,000 and 1:200,000.
   4. The system (TOPSY) for calculation of digital terrain models and for production of contour drawings at the scale of 1:5,000.
   5. The system (PLANICOMP) for primary data collection through photogrammetric measurements.
7. CURRENT OPERATING MODE: The systems are in production mode.
8. PROGRAMING LANGUAGES: FORTRAN, COBOL, Assembler
9. SOURCE: In-house development and vendors

FRANCE

1. ORGANIZATION: Institut Geographique National
   Direction Generale
   136 Bis. Rue de Grenelle
   75700 Paris
   France

2. SYSTEM CLASSES: Digital line graph system, digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: (Not available)
   Processor: C.I.I. Iris 80
   Software:
   (Software configuration not available)
4. GENERAL FUNCTIONS:
   The system performs the following general functions:
   1. Collection of digital data issued from stereoplotters, existing files of position and non-graphic data and digitizers.
   2. Investigation, editing, error correction, and updating of data files and linking of attributes with graphic data.
   3. Output of final graphic and DTM data files for plotting, analyses, and other purposes.
5. PRODUCTS: Digital files and derivative graphics
6. SUBSYSTEMS:
   1. Data Collection System: The system has the capability to collect digital data issued from the following sources:
      a) Photogrammetric surveys
      b) Conventional field surveys
      c) Digitization of existing maps
   2. Data Processing System: The system performs preliminary checking of the data coming from stereoplotter, digitizer, or from existing files. This processing reveals certain recording flaws and other gross errors. The errors are corrected either automatically or with user supplied instructions. After this preliminary editing, the data can be plotted for physical inspection. This allows a closer examination of the map and facilitates detection of mistakes of omission and commission.
   3. Interactive Editing System: This system allows interactive editing, supression, addition, and modification of data elements in the file. Certain computational tasks, such as coordinate conversion (from digitizer table to geodetic system) and adaptations (translation, rotation, similarities, etc.), can also be performed interactively.
   4. GITAN System, an in-house development, is used for data base management operations.
7. CURRENT OPERATING MODE: The system is in production mode.
8. PROGRAMING LANGUAGES: The software is written in PL/I (70 percent) and FORTRAN (20 percent).
9. SOURCE: All production software is in-house development.

IRELAND

1. ORGANIZATION: Ordnance Survey Office
   Phoenix Park
   Dublin
   Ireland

2. SYSTEM CLASSES: Digital line graph system, digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: Altec digitizer
   Processor: DEC PDP 11/34
   VAX 11/78 (Proposed addition)
   Software:
   Applicon Interactive System
4. GENERAL FUNCTIONS:
   The data for large-scale mapping is acquired through the use of digitizer table and aerial survey methods. A batch processing system, called Map Gen package, handles generation and management of digitized contour and general mapping data acquired through the use of flatbed digitizers, aerial survey methods, and stereo digitizers. The facility for interactive data editing also exists.
5. PRODUCTS: Digital files and associated derivative graphics
6. SUBSYSTEMS:
   The Map Gen software package handles elevation data digitized either in stream mode or as digital terrain model. The package has the capability to generate contour lines.
   The system for creating digital line files is still in development stage. For this purpose, a feasibility study has been completed using Altek digitizer and Kongsberg PDS M80 preprocessor. The data is processed by special modules in Map Gen package. The data produced by this package is edited on Applicon Interactive System before being plotted.
7. CURRENT OPERATING MODE: The digital elevation graph system is in operation mode. The digital line graph system is in development mode.
8. PROGRAMING LANGUAGES: (Not available)
9. SOURCE: In-house development and vendor supplied.

NETHERLANDS

1. ORGANIZATION: Cadastral Service of the Netherlands
   7300 GH Apeldoorn
   Postbus 9046
   Waltersingel 1
   The Netherlands

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
   Hardware:
   I/O devices: (Make names of digitizers and plotters not available)
   Processor: PDP 11
   Software:
   Interactive Graphic Design System (IGDS)
   DMRS package
4. GENERAL FUNCTIONS:
   The system is still at research and development stage with the objective of creating an experimental digital cartographic data base for cadastral mapping. Photogrammetry, existing maps, and field measurements are the intended input sources. The system will be designed to output large-scale basic maps, cadastral maps, project maps for land consolidation, and customer defined maps.
5. PRODUCTS: The current development efforts include creation of an experimental data base for digital mapping purposes.
6. SUBSYSTEMS:
   The system is in research and development phase. No clearly defined subsystems have emerged at the present stage.
7. CURRENT OPERATING MODE: The system is in research and development mode.
8. PROGRAMING LANGUAGES: FORTRAN language will be used for the software to be developed in-house.
9. SOURCE: All production software will be in-house development. Some vendor supplied basic applications software will be used.

NETHERLANDS

1. ORGANIZATION: Topographic Service
   Westvest 9
   2611 AX Delft
   The Netherlands

2. SYSTEM CLASSES: Digital line graph system, digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: Gradicon digitizer
   Altek digitizer
   (Make of plotter not available)
   Processors: PDP 11/45
   PDP 11/34
   Software:
   RSX 11M operating system
   Interactive Graphic Design Software
4. GENERAL FUNCTIONS:
   The system is designed to perform the following general operations:
   a) Collection, maintenance, editing, and display of cartographic data issued from off-line digitizers.
   b) Interactive collection, maintenance, editing, and display of culture and terrain data issued from on-line digitizers. The display capabilities include projection of raster data in a 3-dimensional overviewing.
5. PRODUCTS:
   1. Magnetic tape for data plotting.
   2. Data files in Standard Exchange Format commonly used by several organizations.
6. SUBSYSTEMS:
   The system consists of the following component software packages.
   a) CARTOP system is used for cartographic applications on data issued from off-line digitizers. The system includes the capabilities of editing, data base management, and plotting, and scribing.
   b) CULTER system is designed for producing culture and terrain files in an interactive mode. The system has the capabilities for editing, interactive syntex checking, and reformatting from vector data (contour lines) to raster data. The display facilities include displaying raster data of the terrain in a 3-dimensional overview.
   c) The system includes the capability for reformatting digital data files into a Standard Exchange Format commonly used by various Dutch organizations. The purpose is to exchange digital cartographic files in a commonly agreed standard format.
7. CURRENT OPERATING MODE: This system is in production mode.
8. PROGRAMING LANGUAGES: The software is written in FORTRAN IV language.
9. SOURCE: Most of the production software is in-house development. Some vendor supplied software has also been used.

NEW ZEALAND

1. ORGANIZATION: Department of Lands and Survey
   Wellington
   New Zealand

2. SYSTEM CLASSES: Digital line graph system, terrain elevation models
3. RESOURCES:
   Hardware:
   I/O devices: Sumagraphics 1D48 digitizer
   Tektronix 4010 graphic screen
   Broomall 430/101 flatbed plotter
   Processor: DEC PDP 11/34A
   Software:
   Digital Equipment RSX 11M O/S
4. GENERAL FUNCTIONS:
   The aim of terrain model system is the preparation of profile information from digitized contours for use in Wild ORI Avioplan. The purpose of line graph system is to produce metric cadastral maps from existing imperial scale drawings. The program includes production of cadastral maps at the scales of 1:1,000 for urban areas and 1:10,000 for rural areas.
5. PRODUCTS: Plot tapes and interactive display.
6. SUBSYSTEMS:
   The line graph system currently consists of four subsystems:
   a) Digitizing (DIGMAP or MULTIMAP)
   b) Interactive editing (DENTRY)
   c) Addition of descriptors (DESC)
   d) Plotting (PDRAW)
7. CURRENT OPERATING MODE: Terrain elevation system is in operating mode. Digital line graph system is still under development.
8. PROGRAMING LANGUAGE: The programing language of all in-house software is FORTRAN.
9. SOURCE:
   SORA-OP system: Vendor (Wild Heerbrugg Ltd.)
   Line graph system: In-house and vendor (Broomall and Tektronix)

SPAIN

1. ORGANIZATION: Instituto Geografico Nacional
   General Ibanez De Ibero, 3
   Madrid - 3
   Spain

2. SYSTEM CLASSES: Digital line graph system, digital elevation graph system
3. RESOURCES:
   Hardware:
   I/O devices: (Brand and make of digitizers not available)
   Versatec printer plotter
   Calcomp 960
   Tektronix 4014
   Processors: IBM 370
   PDP 11/45
   Software:
   (Description of operating systems not available)
   Calcomp Basic software
   TCS (Tektronix display software package)
4. GENERAL FUNCTIONS:
   The system is capable of performing the following general functions:
   a) Collection of cartographic and terrain model data and loading the direct access data files.
   b) Detection and correction of graphic, alphanumeric (attributes), and cosmetic errors in data files and storing the final files on magnetic tape.
   c) Plotting data files.
5. PRODUCTS: The system produces magnetic tape files of digital data. The tape files can be used for plotting and other purposes.
6. SUBSYSTEMS:
   The system consists of the following major subsystems:
   a) Mechanisms for data collection from the following sources:
   - Digitizers
   - Photogrammetric restitution (Wild EK8 & EK22)
   - Remote Sensing Laboratory (Landsat satellite)
   b) Error detection, error correction, and file update systems allow interactive and batch data editing.
   c) The display system includes capabilities for plotting digital data--maps, contours, and slope maps--on Calcomp pen plotter. For editing purposes, the data can also be displayed on CRT screen.
7. CURRENT OPERATING MODE: The system is in production mode.
8. PROGRAMING LANGUAGES: FORTRAN and Assembler are used for in-house software.
9. SOURCE: All production software is in-house development.

UNITED KINGDOM

1. ORGANIZATION: Ordnance Survey
   Romsey Road
   Southampton SO9 4DH
   United Kingdom

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
   Hardware:
   I/O devices: Ferranti Freesean digitizing tables
   Xynetics 1100 and 1050 flatbed plotters
   Ferranti Cartographic Master Plotters
   Tektronix Graphics display
   Processors: ICL 1906S
   PDP 8
   PDP 11
   Hewlett Packard minicomputer
   Software:
   GEORGE 3 operating system
4. GENERAL FUNCTIONS:
   The system has the capability to perform in such general functions as data collection, file maintenance, data display, and data management.
5. PRODUCTS: Digital cartographic files and derivative graphics
6. SUBSYSTEMS:
   The Data Collection System loads cartographic data onto the map data file and also creates a data set containing control parameters associated with the map data file.
   The Data Maintenance System provides the capability of editing the data files.
   The Display System, derived by the control parameters associated with the data file, produces a wide range of standard plots, including multiple plots.
   The File Management System is used for file management operations for map data files in the data bank.
   The Digital Map Restructuring System provides the capability to break down digital mapping data base (high-level data base) into component features and to build a data base for these components (low-level data base). The reverse process, i.e., creation of high-level data base from low-level data base is also included in the restructuring system.
7. CURRENT OPERATING MODE: All systems in production mode except for the restructuring system which is undergoing trial production.
8. PROGRAMING LANGUAGES: All in-house programs are written in COBAL language with occasional Assembler language statements.
9. SOURCE: All production programs are in-house developments.

UNITED STATES OF AMERICA

1. ORGANIZATION: Defense Mapping Agency
Building 56
U.S. Naval Observatory
Washington, D.C. 20305
U.S.A.

2. SYSTEM CLASSES: Digital elevation graph system, digital line graph system

3. RESOURCES:

Hardware:

I/O devices: Bendix DataGrid digitizer
Tektronics 4014 Graphic Display
Comtel Vision I Image processing system
Versatec Electrostatic plotter
Application Inkjet plotting system

Processors: PDP 11/45
UNIVAC 1100

Software:

RXS-11M operating system for PDP 11/45

4. GENERAL FUNCTIONS:

Software packages designed for the collection, processing, maintenance and exploitation of digital cartographic data in support of advanced weapon systems and charting requirements.

5. PRODUCTS: Digital cartographic files and a wide range of display products.

6. SUBSYSTEMS:

The Digital Image Processing System (DIPS) is designed to provide the capability to exploit digital remotely-sensed data for hydrographic charting applications.

The Mosaicking and Regridding System (MARS) is a post-processing system for terrain elevation data from UNAMACE, geographic, or UTM formatted input tapes. Data from different Digital Terrain Matrices (DTM) may be mosaicked together and output as one DTM on tape. The data from one format (projection) may be transformed to another format (projection).

The Planar Interpolation Processing System (PIPS) is designed to handle conversion of the digital contour information on a map sheet to a digital matrix of elevations at a specific geographic interval, depending upon map scale and latitude.

The Culture Data Maintenance System (CDMS) performs a number of culture validation functions upon the raw Digital Land Mass System (DLMS) data files before final DLMS files are created. These functions include culture building, culture validation, file merging, area panelling, and creation of final DLMS culture file ready for plotting.

The standard Digital Terrain Elevation (DTED) maintenance system includes such operations as formation of matrix from CALMA data, LIS table or geographic data, or DLMS formatted data and to revise this elevation matrix for acceptability to the data base. The system can also reformat the terrain data from the data base to the specifications of other users. The system includes capability to verify common boundary elevations between standard terrain files and to eliminate gross discrepancies in the terrain files.

The Exploitation/Display System has the following display capabilities of terrain elevation data:

- Three dimensional oblique map display as viewed from any direction
- Display using polynomial coefficients which characterize terrain as developed by contouring by surface averaging concept.
- Variable sun-angle relief and shaded relief.
- Traditional cartographic displays.
- Symbolization of digital cartographic feature data for automated color separation plotting.
- Synthetic sensor scenes from digital terrain and culture data bases for a variety of sensors.

7. CURRENT OPERATING MODE: DIPS: The system is in system-design mode. All other systems are in operation mode.

8. PROGRAMING LANGUAGES: The softwares are written in FORTRAN and MACRO-11 Assembly languages.

9. SOURCE: The source of the software includes in-house efforts, vendor supplies, and contract developments.

1. ORGANIZATION: U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Survey
Rockville, Maryland 20852
U.S.A.

2. SYSTEM CLASS: Digital line graph system
3. RESOURCES:
Hardware:
I/O devices: CALMA digitizing system
Bendix DataGrid digitizer
Calcomp flatbed plotter
Laser raster production plotter
Xynetic plotter
Varian Statos Hard Copy unit
Tektronics 4631 Hard Copy unit
Processors: IBM 360/195
UNIVAC 1100/42
VARIAN V-76
Software:
Total Database Management System
Calcomp Basic Software
4. GENERAL FUNCTIONS:
a) Data acquisition
b) Evaluation, storage, and compilation of data
c) Data management
d) Automated graphics
5. PRODUCTS: Digital cartographic files and derivative graphics
6. SUBSYSTEMS:
The Nautical Charting System consists of the following major subsystems:
FDA: The Field Data Acquisition Subsystem includes the conduct of basic hydrographic and photogrammetric surveys and processing (i.e., compilation, editing, and verification) of the survey data collected.
AIS: The Automated Information Subsystem controls the data storage, retrieval and update subsystem and the nautical chart compilation subsystem.
AGS: The Automated Graphics Subsystem includes production of nautical chart drawings. The charts are produced on Calcomp flatbed plotters and laser raster plotter.
The management subsystem handles such operations as planning, scheduling, budgeting, management information, system logistics, etc.
7. CURRENT OPERATING MODE: The system is in partial production mode and expected to be in full operation by 1983.
8. PROGRAMING LANGUAGES: FORTRAN, Assembly, and COBOL languages.
9. SOURCE: Most of the software is supplied by contractors and vendors.

1. ORGANIZATION: United States Geological Survey
National Center
Reston, Virginia 22092
U.S.A.

2. SYSTEM CLASSES: Digital line graph system, digital elevation model system
3. RESOURCES:
Hardware:
I/O devices: Gradicon digitizing tables
Altek digitizing tables
M&S interactive graphic system
Gerber plotters
Calcomp plotters
Versatec plotters
Processors: IBM 370/155
PDP 11/70
Software:
Support software for Gerber, Calcomp, and Versatec plotters
RSX 11M OS
IBM 360/370 OS
System 2000 DBMS
4. GENERAL FUNCTIONS:
The design objective of the system is to create a capability of producing cartographic information in machine processable format. The system attempts to structure encoded data in a form that can serve the processing needs of Geographic Information Systems (GIS).
5. PRODUCTS: Primarily digital cartographic files. Derivative products such as graphics of various qualities are planned.
6. SUBSYSTEMS:
1. Unified Line Graph Encoding System (UCLGES) is capable of encoding line graphs into topologically structured data files. The system has the capability to edit, verify, display and archive generated data files.
2. Digital Elevation Resampling Systems (DERS) has the capability of assembling elevation models from different coordinate systems, orientations, and sampling rates and creating an integrated model in a chosen reference system, orientation, and spacing.
3. Digital Cartographic Data Index (DCDI) is a management system for digital cartographic files. The system employs support from System 2000 and uses high density tape for archival storage.
4. General Transformation System (GTS) is a package of programs capable of transforming the coordinates of a point from one map projection to another. The system supports 20 different map projections and has the capability for efficient transformation of a large number of points.
7. CURRENT OPERATING MODE: All systems are in production mode.
8. PROGRAMING LANGUAGES: FORTRAN, PL/I, Assembly
9. SOURCE: In-house, contract programing, and vendor packages.

Concluding remarks

The following remarks are based upon examination of the survey's results:

1. Digital data encoding remains to be the phase of digital mapping that is most actively researched and developed. This is quite understandable since it tends to consume the largest portion of the initial investment in any typical digital mapping program. There are strong indications that data structures and the attending problems of encoding graph topology are attracting increased attention from researchers in the field. One would appreciate this, once it is realized that the range of applications that digital cartographic data can serve is directly related to its structure. In a sense, data structure determines the information content of a file that can be used to serve a specific application. Cost effectiveness of digital mapping can be enhanced by widening the range of applications through the proper choice of a data structure for its digital files.

Data encoding systems are most influenced by a mapping organization's unique environment. Their development tends to reflect the unique characteristics of the primary data collection systems to which they directly interface. Transplanting data encoding systems across organizational boundaries does require much more than duplicating the hardware and software environment. Some changes in established organizational practices are often needed. Resistance to such changes may explain what appears to be a proliferation of efforts to reinvent the wheel. Even when resistance is absent, a great deal of effort is often needed to fit automated systems to the unique organizational objectives. It goes without saying that exchange of experience could prevent very costly and often hard-to-correct false startups and help to speed up system development process.

2. The problem of maintenance of digital cartographic data remained, in the view of many, to be another phase of the data collection system. After all, we need facilities in the data collection phase to edit and correct encoding errors. This may be true, to a great extent, for unstructured data bases.

In data files where topology as well as metrics are encoded, methods for identifying and correcting mistakes during the file building stage would be very costly and cumbersome to support. Experience in this area is scarce since there is no large structured cartographic data base in existence that has reached a maintenance stage of operation. Effective methods to rebuild files which have been locally unstructured, because of editing operation, are currently under study in some organizations.

3. Great strides have been achieved in developing software to create publication-quality graphs from digital cartographic files. Attempts to create independence between the graphics software and display hardware have been impressive. Early attempts to standardize function and calling sequences for hardware-support software have been recently evolving into standardization of plotting instruction files. Serious attempts at the national level in many countries have been reported which may result in international exchange standards for digital graphic display files.

The inherent ability of structured digital cartographic files to yield valuable statistics about their spatial information content is being utilized in many instances as a substitute for graphic display. These quantitative measures are especially valuable when cartographic data are used to support operations of geographic information systems.

There seems to be very little reported success in the area of cartographic generalization. To avoid possible difficulty, multiple data bases resolving the cartographic domain at various levels are being used to support several ranges of map scales. This costly approach will probably continue to dominate until some practical methodology is developed in the area of automated map generalization.

4. Data management is the function which assumes the responsibility for storage, retrieval, and general monitoring of the operation of any data base. The philosophy of management is generally controlled by the size of the data base. For instance, in large data bases (larger than 10^8 bits), several hierarchies for management must co-exist to provide a practical solution to the efficiency of management operations. There is no evidence to support some claims for a special methodology to manage spatial data. The continuing progress in the general field of data management (both at the hardware and software levels) will undoubtedly benefit digital mapping.

5. While the cost of hardware continues to decline, software is getting more complex and its cost is rising rapidly. Protection of investment in software is difficult due to continuing advances in the field of electronics. Standardization of programing language, file organization, data mananagement system, etc., help to some degree, but it certainly does not completely eliminate the problem. While standardization has been attempted within organizations, national and international standards have been nonexistent. It would seem that it is time to start putting into motion some international effort to examine the possibility and desirability of such standards. The International Society for Photogrammetry can help a great deal by providing the necessary umbrella under which such an effort could proceed.