

**DIGITAL ELABORATION OF MAPS  
FOR THE NATIONAL ATLAS OF POLAND**

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**Abstract**

A new monumental national atlas called *Atlas of the Republic of Poland* is being under elaboration. Part of the Atlas has been elaborated by computer means. This paper presents the methods of digital elaboration of selected sheets. The main objective of the article is description of technology used and discussion on emerged problems. It's specially focused on database creation and database generalization. The described scope of works ranges from initial editorial works through the creation of maps by GIS software to the exposing of final drawings by film writer for direct providing to publishing house.

The concept of elaboration of the new National Atlas of Poland emerged in the beginning of eighties. Its predecessor, being elaborated for nearly twenty years, was published in 1978. The loss of timeliness of many maps in the previous atlas, especially social and economic topics and the great readers' demand made easier the decision on undertaking works on the new national atlas. The present state of the work progress on that great cartographic publication is estimated on 60 %. The first dozens atlas' sheets has been already provided to bookshop distribution.

In the foreword, the publisher indicated that the Atlas of the Republic of Poland had brought to the end the period of censorship, ubiquitous propaganda and lack of access to much of fundamental data. It is, at the same time, the starting point for a new era, and it will constitute a reference point for the future achievements of the new democratic Poland.

The conceptual framework of the new National Atlas has been elaborated at the Institute of Geography and Spatial Organization of the Polish Academy of Sciences. The Surveyor General of Poland is the publisher and the Polish Cartographic Publishing House is responsible for printing. The Environmental Information Centre GRID-Warsaw has initiated the computer elaboration of final diapositives for selected atlas sheets. They are now being prepared at the GRID-Warsaw Centre and at the Laboratory of Cartography and Geographical Information Systems of the Institute of Geography and Spatial Organization of the Polish Academy of Sciences.

According to the conceptual framework, the Atlas has been divided onto four publishing parts constituting the following compact essential units:

- part I - *State, Territory, Organization* comprises of maps presenting lands of Poland in territorial extension, historical review and spatial organization of the State,
- part II - *Environment* is devoted to the natural environment of the country; consists of information on geological formation, relief, climate, flora and fauna, as well as on changes and protection of the environment,
- part III - *Society* will present population of Poland in various aspects and related social problems,
- part IV - *Economy* will be focused on economy in broader sense, illustrating the state and development of its particular branches with their mutual interactions.

The Atlas as a whole comprises of 150 sheets with maps on the front and comments on the back of a page and additionally text part.

The first two parts of the Atlas of the Republic of Poland have been already completed and printed out. The third one is presently edited and under preparation to printing, whereas the fourth one is being elaborated by authors. The last one will be ready in 1997.

The Atlas has been designed as a set of detached sheets of 70 cm by 52 cm size, folded to the size of 42 cm by 52 cm. They are set in stiff box. The sheets have a decimal numbering system enabling supplementing existing set with new maps. The detached form makes possible exchange of out of date sheets. Thanks to these assumptions, the Atlas has a form of permanent publication.

Each sheet is provided with the comment on substance and method used as well as with the references. The legends and all explanations are edited in Polish and English language versions.

The sheets of part one and two of the Atlas have been elaborated by traditional means. The sheet titled *Poland from Space* constitutes the only exception. It presents the merged and unified satellite image of the whole country at the scale 1 : 1 500 000. The MSS scenes have been processed at the Institute of Geodesy and Cartography, whereas the final films for printing have been produced at the GRID-Warsaw Centre.

This paper presents the method of digital elaboration of sheets to the part three of the Atlas. The main objective of the article is description of the sequence and scope of the works and discussion of emerged problems and ways of solving them.

The idea of computer assisted elaboration of selected maps in national atlas was born in seventies. One year ago, an experimental works on one of the sheets of part three have been undertaken. The digital technology of Atlas publishing was subject of the research works carried out at the GRID-Warsaw Centre. The results of these works were directly implemented in preparation of the first experimental sheet. After successful completion of that experiment it is still being used for next sheets.

The most maps in part three belongs to thematic maps elaborated by means of choropleth and diagram methods. They are based on the uniformed administrative divisions background. The digital elaboration of such maps required creation of geometrically correct spatial database for multiple use. It was based on various administrative divisions relevant to the specific date, scale and level.

The basic scale of maps elaborated on the basis of administrative divisions has been set to 1 : 3 000 000. The high quality maps consisting of the boundaries of communes (about 2700 units) relevant to years 1988 and 1992 has been prepared by Editorial Team of the Atlas and provided to the GRID-Warsaw Centre for further processing. The third reference map presented about 300 counties in 1970 year.

All of the above mentioned reference maps presented at the scale 1 : 3 000 000 in quasi-stereographic azimuthal projection has been scanned with the resolution 300 dpi. The house developed GIS system called SINUS has been applied for the purpose of vectorizing and next processing steps.

The vectorizing programme performed first skeletonizing of raster image by reducing pixels representing course of lines to the one-pixel width central chain for each arc segment. In the second run, the vector structure were calculated by identifying nodes and finding sequence of vertices. The weed and dangle tolerances could be defined for each data set. A number of other parameters facilitated the process of converting raster image to vector structure. Some of them determined also the degree of line generalization. The vector files has been converted from SINUS system structure to ARC/INFO one.

The high quality of scanned documents enabled considerable reduction of vector editing stage. The geometry of new digital sets fitted perfectly to the original drawings, but it had no codes attached. The polygon (county or commune) encoding was consisted with the system of administrative units' identifiers introduced by the Central Office of Statistics for all official statistics. The identifier for particular commune consists of two digit code representing one of 49 voivodships, which is followed by three digit code relevant to some sort of sequential number of a commune.

The process of labelling all polygons has been performed by means of interactive procedure. It was followed by automatic line encoding based on codes of polygons and rules of coding described earlier. Thus, using specially prepared programme, the codes of three levels of boundary significance has been distinguished. It was very important for the cartographic design, implemented on the stage of final map elaboration.

One additional rule has been also introduced. It concerns the shape of very small polygons, representing location of some cities. It has been decided that all polygons with area smaller than or equal to  $1 \text{ mm}^2$  would be replaced by a circle of  $1 \text{ mm}^2$  area. The special programme was written in ARC/INFO Macro Language (AML). It created all circular polygons, coded them and removed all replaced small polygons.

The created database was subject of thorough checking and verifying. Then after editing the final version of all three layers representing administrative divisions in 1970, 1988 and 1992 years at the scale 1 : 3 000 000 were ready for further use.

According to the principles elaborated by the Editorial Board of the Atlas all thematic maps in part three are presented in three scales, namely 1 : 3 000 000, 1 : 4 500 000 and 1 : 6 000 000. The creation of databases for two smaller scales required generalizing of lines on the basis of created database for 1 : 3 000 000 scale. The generalizing process has been performed mainly by automatic means in ARC/INFO system. The commune boundaries were separated from shore line and independently processed in order to distinguish these two features. The course of the boundaries was more coarse, so the generalization degree ought to be higher.

Several versions of generalized geometry of commune boundaries as well as shore line were subject of analysis performed by the editor in charge of background maps. The best one was selected, however it contained some lines which had to be corrected by means of interactive editing. They represented peninsulas and small bays. After scale reducing, some lines were too close to each other from the graphical view point. Thus they required individual editing.

Like in case of the database for mapping at the scale 1 : 3 000 000, there has been applied a selection of small polygons in order to present them in standardized form of circles visible at the scales 1 : 4 500 000 and 1 : 6 000 000 adequately. In case of the last two, the size limits of these units were respectively smaller in real measures (in km<sup>2</sup>) and similar to the first one in map units.

As a result of the above described works, six reference layers with commune boundaries have been created. The following table summarizes them.

Year/scale	1:3000000	1:4500000	1:6000000
1970	X	-	-
1988	X	X	-
1992	X	X	X

Additionally, for each year/scale (all together 9) the derived reference layer, containing boundaries of the first level administrative division (voivodships) have been formed.

The elaboration of atlas sheets is compound - as usually - of three stages:

1. author's concept .
2. cartographic design
3. final drawing elaboration

The author of each sheet is responsible for selecting of map themes and relevant statistical and descriptive data. He also prepare the final version of all comments.

The cartographic design is elaborated by team of the Laboratory of Cartography and Geographical Information Systems of the Institute of Geography and Spatial Organization of the Polish Academy of Sciences. They prepared general technical guidelines for all sheets in the volume three. Each individual sheet is designed by one editor in charge, who is responsible for:

1. choosing cartographic presentation method
2. legend design
3. sheet internal layout
4. elaboration of statistical plots
5. selection of colours for each map and supplementary elements of the legend
6. selection of fonts and their size
7. defining line width

Some of these works are carried out by means of computer.

The layout of the sheet with all comments and statistical data in digital form are provided to the GRID-Warsaw team for computer assisted elaboration of final drawings. Part of sheets are also processed by the Laboratory of Cartography and Geographical Information Systems of the PAS. The final drawing elaboration consists of the following tasks:

- elaboration of standard maps in digital form comprising boundaries of administrative units and names
- mapping on the basis of statistical data using choropleth or diagram method
- elaboration of legends and diagrams
- sheet layout composition based on individual maps, legend and diagrams
- first proof plotting of the sheet
- editing after first checking
- second proof plotting
- computer controlled film writing
- cromalin proof

In the above mentioned processes have been performed by using several software solutions. For mapping the ARC/INFO system (SUN workstation version) has been applied. Several macro language application programs have been developed in order to speed up the routine processing. The sheet composition is performed by means of the Adobe Illustrator graphical software. Several additional converting and accelerating programmes have been also developed.

For the proof plotting process a Hewlett-Packard Design Jet plotter is used. It provide copies with 256 colours and 300 dpi resolution. These parameters are

satisfactory for checking the correctness of digital record of the sheets. Actually all possible errors can be visible on such copies.

The processes of digital elaboration of sheets for the national atlas are much more reliable than traditional one. They are also less time consuming, especially in presenting phenomena described by statistical data. The development of computer technology will definitely accelerate the process of map editing and publishing. It is very important for map updating. The new version publishing of many maps of the Atlas was one of the main conceptual assumption of the Atlas of the Republic of Poland.

In the nearest future the electronic atlas of Poland will be developed and the experiences of digital elaboration of the Atlas being discussed in this paper will be broadly exploited.