MAKING THE 1:50.000 SCALE MAP

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***Abstract**: The purpose of the article is to reveal in short the work behind the 1:50.000 scale map. The project was developed inside National Center of Cartography during a two year period between 2013 and 2015.*

***Keywords:** cartography, maps, generalization, cartographic symbology*

1. Introduction

Why the map at scale 1:50.000?
So, the overall purposes in starting the project were:

- the old paper maps were out of date and no longer represented the present terrain reality;
- the need of an up to date map at a reasonable scale that can be used as a decisional support;
- the processes in map making and printing changed;
- and this is what we do and what defines us, according to order no. 890/2015 published in the Official Journal of Romania First part, no. 657 from 31.08.2015.

The development of the project was possible due to the constant sustained effort for geospatial data collection within the project TopRo5 (Romanian Topographic Reference Plan at 1:5.000 scale) and the outcomes of the European project called LAKI (Land Administration Knowledge Improvement) implemented in 2012.

In this context new concepts were introduced such as cartographic database, model generalization and graphic generalization.

As the final intended objective of the project was to obtain the printable map sheets at 1:50.000 scale for the entire territory of Romania, the emphasis was put on the easy readability of the maps, resulting in loss of positional accuracy, especially where graphic conflicts emerged and displacement operations were needed.

The project started in January 2013 and was finished in November 2015 and because of its complexity it was implemented over three main phases and involved the entire technical staff of the institute.

First phase included:

- the design and structure of the cartographic database;
- updating the geospatial information from TopRo5;
- collecting new geospatial data;
- model generalization;
- adding symbology and labelling.

The second phase included the cartographic generalization processes and the third one the preparation of the map sheets for the 1:50.000 scale for printing.

During the implementation, where possible, automatic processes created in Model Builder and Python were used.

The overall workflow of the project can be seen below in figure 1.

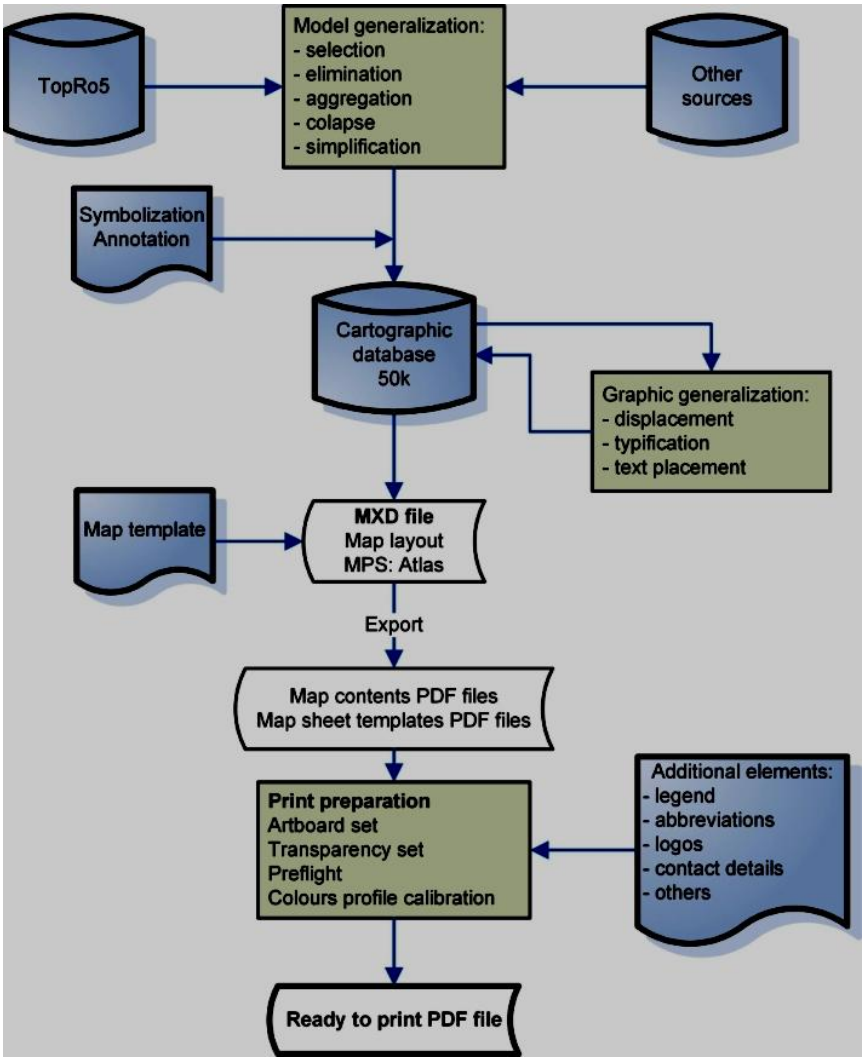

Fig. 1. The workflow of the project

2. Inside the project

The project started with a series of technical meetings to analyse the data needed to make the 1:50.000 scale maps, the owned information and the data to be collected.

In this regard, for the final outcome of the project to be met the following data sources were used:

- TopRo5 – the main source of data;
- Ministry of Environment, Waters and Forests for protected sites;
- National Meteorological Administration for weather stations location;
- National Geodetic Fund;

- National Institute of Statistics for settlements population;
- Georeferenced old paper topographic maps at 1:25.000 scale;
- Ortophotos for collecting new data.

Before starting the implementation phases of the project, pilot tests were made on three different areas (in mountain, hill and plain) in order to evaluate the duration of the actual works and the outcome of it.

These led to updating the cartographic key developed within the institute after analysing national and international cartographic documents and development of graphic generalization editing instructions.

a. First implementing phase

The first implementing phase started with the design and structure of the cartographic database. Feature type were set, type of geometry, minimum sizes to be met, attributes needed to symbolize the objects. Also, transformation steps (model generalization processes) needed to obtain the set outcome were established.

	A	B	C	D	E	F	G	H	I
1	**Grup**	**Clasa de obiecte**	**Geometrie**	**Dimensiuni minime**	**Atribute folosite pentru simbolizare**	**Valori atribut**	**Observatii**	**Procesare**	**Simbolizare**
2	DENUMIRI GEOGRAFICE	ANNOTATION	N_A					transformarea etichetelor în adnotări	
3	PUNCTE GEODEZICE	PTRAING	punct				extrase din baza de date ToPRo5		
4	LIMITE	Limite_adminsitrative	linie		Nivel_limita (trebuie adaugat)	Frontiera Judet Municipiu Oras Comuna Sector Coasta	va fi extrasă din baza de date din feature class UAT_LIMADT. ATTENȚIE! Pentru nivelele mai mici de județ nu există clasificare; acestea sunt incluse in valoarea generala de Unitate Administrativ Teritoriala.	procesare spațială pentru obținerea nivelelor inferioare	Transparență 30%
5		Parcuri_NationaleNaturale_contur	linie	I >= 100 m și S >= 10.000 mp			Clasa de obiecte va fi extrasă din baza de date **Arii_protejate** din feature class **parcuri**. Sursa bazei de date este Ministerul Mediului fiind puse la dispoziție gratuit prin site-ul acestora.	Transformare din poligon în polilinie	simbolul depinde de direcția de vectorizare
6		Rezervatii_contur	linie	I >= 100 m și S >= 10.000 mp			Clasa de obiecte va fi extrasă din baza de date **Arii_protejate** din feature class **rezervatii**. Sursa bazei de date este Ministerul Mediului fiind puse la dispoziție gratuit prin site-ul acestora.	Transformare poligoanelor cu I >= 100 m și S >= 10.000 mp în linie	simbolul depinde de direcția de vectorizare
7		RezervatiiP	punct	I < 100 m și S < 10.000 mp			Clasa de obiecte va fi extrasă din baza de date **Arii_protejate** din feature class **rezervatii**. Sursa bazei de date este Ministerul Mediului fiind puse la dispoziție gratuit prin site-ul acestora.	Transformare poligoanelor cu I < 100 m și S < 10.000 mp în punct	
8		Puncte_de_trecere	punct				va fi preluat din baza de date Puncte_de_trecere		

Fig. 2. Database structure

In the updating process were included the administrative boundaries, road network, dams, buildings, cemeteries, churches and contours.

New geospatial data was collected such as: cable transport, wind turbines, oil and gas wells, mines, quarries, waterfalls, cave entrances, meteorological stations and more.

Model generalization implied data transformations such as:

- selection/ elimination of objects according to the minimum set sizes;
- collapse and geometry transformation from polygon to point or line and line to point;
- aggregation of objects with the same characteristics;
- simplification of objects density such as river network.

Example of model generalization for roads:

Road centerline objects having the attribute bridge or tunnel and the length less than 100 m were transformed to points and saved in the cartographic database in Pod_drum (Bridge_road) and Tunel_drum (Tunnel_road) feature classes. The same road centrelines were aggregated with the neighbouring roads and saved in cartographic database in Drumuri (Roads) feature class.

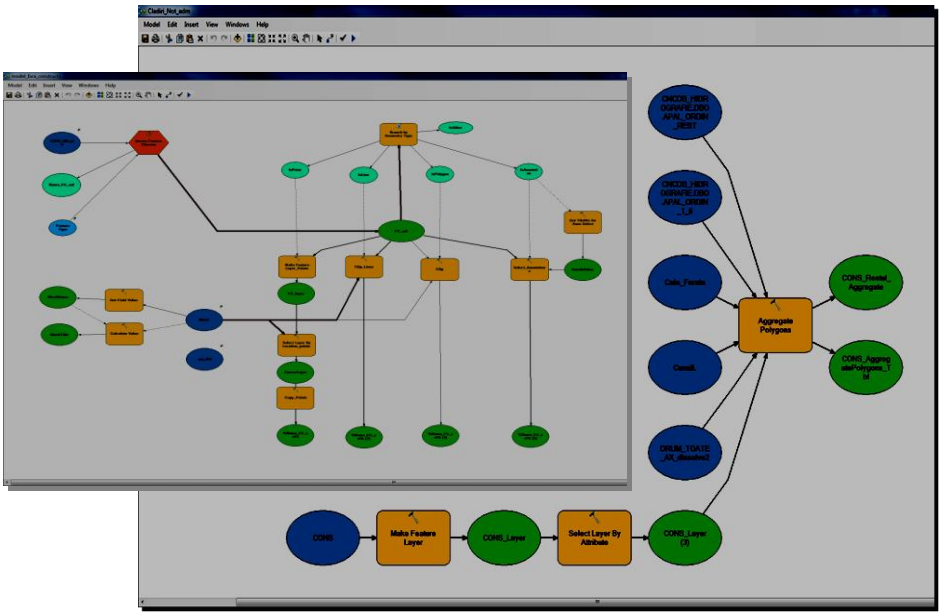

Fig. 3. Generalization processes

After all the feature classes were added in the cartographic database they had been symbolized according to the cartographic key for scale maps 1:25.000, 50.000 and 1:100.000 created by the National Center for Cartography.

The symbology information has been stored inside the database as representations.

Following cartographic rules of text placement, the objects were labeled and the text has been saved in the database as annotation.

b. Second implementing phase

The second implementing phase consisted in graphic generalization and involved especially operations of displacement and text placement refinement.

Displacement operations were needed because of the graphic conflicts between the symbols of the elements after these had been applied to the objects.

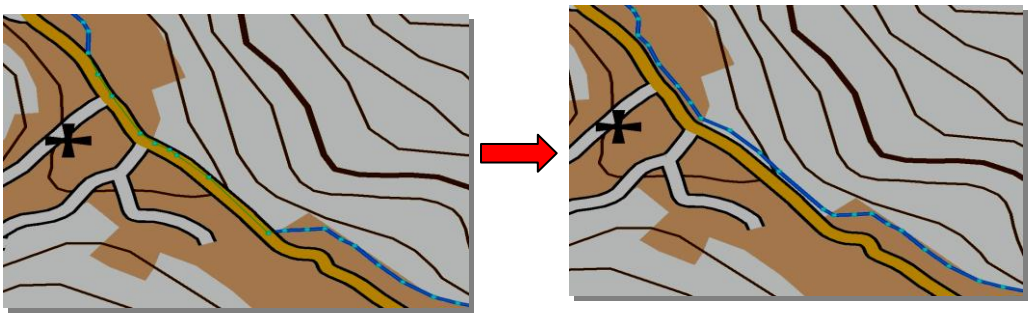

Fig. 4. Displacement

The refinement of text placement was needed because the automatic labeling, although is following some general rules of text placement, can not include all the possibilities that can appear. Also, some geographical names, collected as point geometry, could not be displayed automatically at their best fit in order to describe the elements they represent. In this context, additional text editing was necessary.

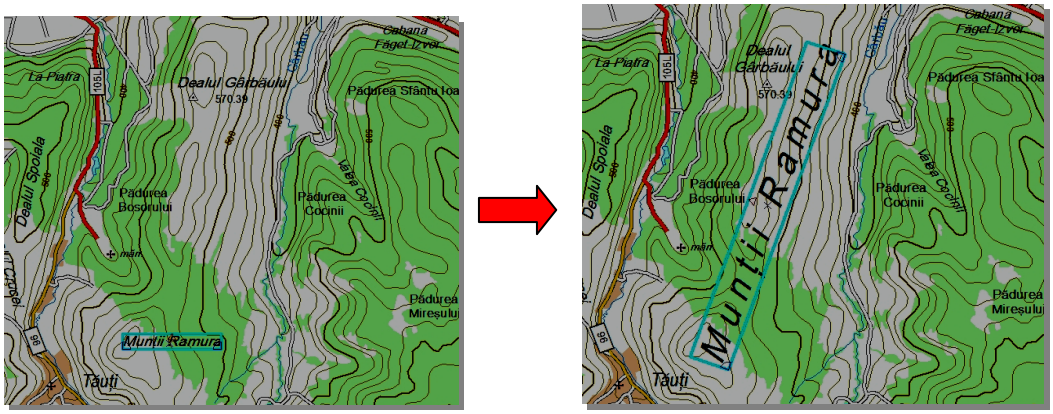

Fig. 5. Text placement and editing

For this phase the cartographic generalization was done by technical operators on 1:50.000 scale grid cells. Each grid cell was exported in a database having the name of the cell at the finalization of its editing.

Reporting and data exporting have been done by automatic tools developed by IT department.

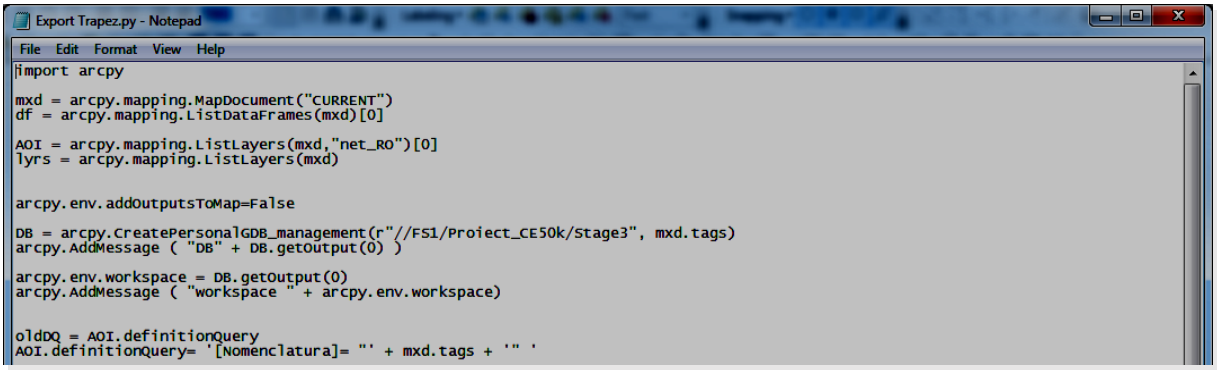

Fig. 6. Grid cell export process

c. Third implementing phase

The third implementing phase involved preparing the map sheets for printing.
Through automatic processes developed by the IT department this included:

- exporting the maps content to pdf files (portable document format);
- exporting the map templates for each sheet;
- obtaining the magnetic declination and the QR (quick response code) for each map sheet;
- combining exported files and additional information such as the legend, abbreviation list, logos, magnetic declination, QR, etc.
- final printing editing like adding transparencies, artboard set, colour profile calibration.

An example of the final output of the project can be seen in figure 7.

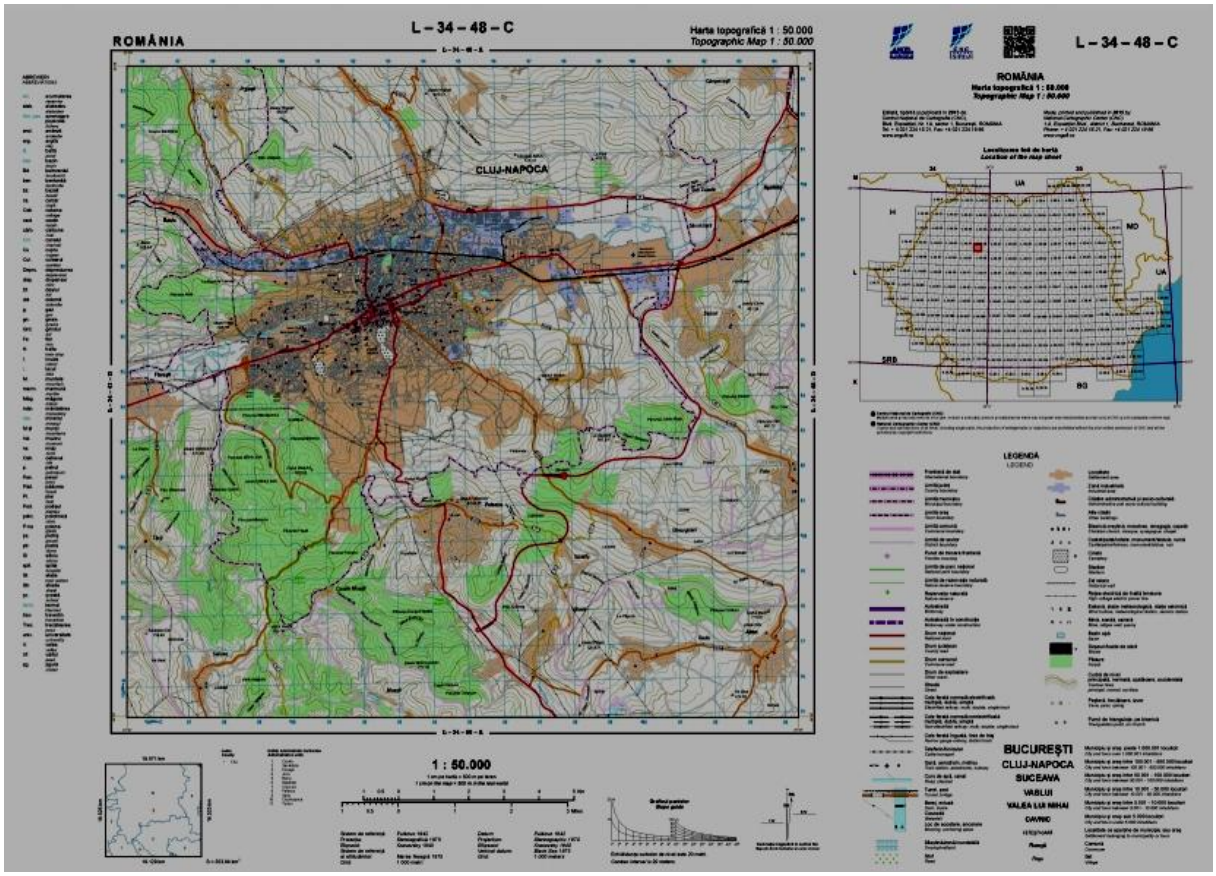

Fig. 7. Example of 1:50.000 scale map sheet

3. Conclusions

Making the map sheets at 1:50.000 scale was a challenge considering the big difference in scale between the main source of data, TopRo5 and the intended outcome.

This gap was overridden using generalization processes. Model generalization as well as graphic generalization.

The inteeded objective of the project was reached by obtaining 737 map sheets at 1:50.000 scale covering the entire territory of Romania.

With the help of IT department automatic processes were used to extract, transform, combine data and keep track of the ongoing works.

Beside the main objective of the project complemetary outcomes were obtained at the finalization of it:

- obtaining the cartographic database at scale 1:50.000 that can be maintained and updated;
- possibility to offer view web services between 10.000 and 40.000 scales.

4. References

*** - *www.ancpi.ro*