NEW TOPOGRAPHIC STANDARD FOR CROATIA

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Abstract

In the late 2009, a new topographic survey will be completed along with the production of a topologic database and topographic map in the scale of 1:25,000 (TK25) for the entire territory of the Republic of Croatia. In order to carry out this project, the State Geodetic Administration and the Croatian Geodetic Institute have developed and implemented a new topographic standard for Croatia defined in three steps. The entire process began by the definition of the „Official Topographic, Mapping and Information System" – STOKIS, followed by a detailed development of the „Croatian Topographic Information System" – CROTIS, and the detailed specifications of the production process and quality control of the data collected and maps produced, for which purpose the Croatian Geodetic Institute was, among other things, established. Since the complete topographic survey and map production were outsourced to private geodetic companies in Croatia that, in parallel to the production, also adopted the technology and standards, the implemented solution is a specific Croatian product.
The paper describes the chain of actions and procedures that were implemented in a very short span of 14 years, four of which were used for pilot projects and the production preparation while the next ten years yielded the production of 600 new sheets of topographic map in the scale of 1:25,000 that facilitated the realization of the overall projects and, thus, establishment of the new topographic standard for Croatia.

1. Introduction

Before Croatia gained its independence, the development of topographic maps in all scales - with the exception of the State Base Map in the scale of 1:5000 - was under the military jurisdiction, and the Military Geographical Institute in Belgrade was responsible for their production. In terms of the official mapping, Croatia had, at the outbreak of the war, only prints of topographic maps. The first task of the State Geodetic Administration (SGA) was to scan maps and print them in sufficient numbers for the national defence purposes. In such an adversary situation, the great demand for topographic maps generated the idea of the Croatian topographic map although, according to the then valid Law on Geodetic Survey and Land Cadastre (Official Gazette, 1974), the production of topographic maps was not defined as being the SGA jurisdiction (Bačić et al., 2009).
After Croatia gained its independence in 1992, projects were launched for the purpose of defining the scope of the SGA and the geodetic operative aimed at producing topographic maps and establishing the services that would carry out such an important project.

The first study showing the future official mapping organization was the *Study on the Establishment of the Official Topographic and Mapping IT System of the Republic of Croatia* (Institute for Photogrammetry, 1992). The system organization was proposed in such a way as to have the SGA responsible for the system functioning (legislation, planning, financing, quality control and distribution) while the production was to be taken over by private geodetic companies.
The process started with the definition of the „Official Topographic and Mapping Information System" – STOKIS and continued with the development of the „Croatian Topographic Information System" – CROTIS, setting up the standards in the production of the official spatial data in the Republic of Croatia (RoC), (Landek, 2009).
Special attention in the development of the Croatian official mapping was paid to quality control so the Croatian Geodetic Institute (CGI) was founded in 2001, taking over the quality control of the produced topographic products. Since the funding options were limited to the State budge of the Republic of Croatia throughout that period, the production of TM25 was co-funded by the local government and public companies expressing their interest as early as that, and recognizing the importance of the spatial information. The co-financing model or the provision of the necessary funds consists of 50% being provided by the SGA while the remaining 50% is provided by interested co-financiers, as will be elaborated later on in the article.

2. Contracting mode and funding of the TM25 production

The funds available from the budget and reserved for the State Geodetic Administration were not sufficient to complete the works related to the TM25 production in the planned, relatively short period of time. Therefore, all stakeholders (potential users) in the society were approached in order to familiarize them with the importance and usefulness of the spatial data. Thereby, it is important to mention that the Republic of Croatia changed its social and political system and that it was difficult to convince the local government units and public companies that they needed to co-finance the production of new spatial backgrounds (maps), given that the same had been the responsibility of the State in the earlier social and political system.
The first example of the TM25 co-financing materialized in 1997 for the area of the City of Zagreb (the capital of the Republic of Croatia). Since the number of the inhabitants in Zagreb, due to the war, was boosted by a significant number of refugees that took up residence there and started to build at the outskirts of the city, there was an urgent need to produce new topographic maps in order to enforce the urban zoning and development in the proper way. The topographic maps that existed for that area were not up-to-date and did not reflect the actual situation in the field.
The funds were provided through the involvement of the City of Zagreb according to the previously described model. The project was carried out successfully within the planned deadlines and fulfilled the expectations of the services in charge of the planning and the adoption of the zoning plans of the City of Zagreb.
Since other towns were in an almost identical situation as was the City of Zagreb, their mayors started to voice their interest for the production of the new TM25 according to

the same co-funding model in order to solve the problem of adopting the spatial plans for their respective towns.
In the same period, laws were passed, obliging the local governments to adopt spatial plans until a certain date.
From 2000 until the present when the first cycle of production of all TM25 sheets for the entire territory of the Republic of Croatia is near its completion (the Republic of Croatia spreads over 594 TM25 sheets – one TM25 sheet covers the area of 13,750 ha), the counties took over the co-financing of the TM25 production for their area together with towns and municipalities.
Certain ministries and larger State and public companies got involved in the program of co-financing the TM25 production, showing interest in obtaining the new mapping backgrounds. The project of producing the TM25 has been co-funded to a significant extent by: Ministry of Environmental Protection, Physical Planning and Construction, Ministry of Economy, Labour and Entrepreneurship, Ministry of Defence, Ministry of Culture and public companies such as Croatian Waterways, Croatian Forests, JANAF (State oil distribution company) and PLINACRO (State gas distribution company).
The age of the currently produced maps is between 2 and 12 years. The SGA plan is to have in the next five years all the maps updated in order for the topographic maps containing the information not older than 5 years to be produced for the Republic of Croatia by 2014.
The co-financing will be continued in the upcoming period, given that there is a readiness and interest of all the stakeholders that have been participating in co-financing until now. The official topographic standards in the Republic of Croatia

3. The official topographic standards in the Republic of Croatia

Dating back to first map illustrations, the purpose of mapping has not significantly changed or rather the maps has always been one of the most important source of information on a certain area. With the advent of computers and computer-based graphics, the information previously accessible only in analogue form has experienced a certain revolution in the manner of being displayed, collected and stored.

3.1 Official Topographic and Mapping Information System – STOKIS

The main reason for launching the STOKIS project was to establish and form the official mapping and cartographic information system of the Republic f Croatia in the fields of topographic surveys and production of State topographic maps.
The entire concept is divided into primary and secondary models of topographic maps in which the primary model is created by the logical division of the Earth's surface into topographic objects / types to which certain attributes are added, while the secondary model is created after the addition of the mapping signatures or rather after all the rules of mapping generalization have been applied.
The topographic model and the mapping model may be used for drafting tertiary models. The data from the database may be used for preparing the graphic primers and

printing the graphic maps in analogue form. The users may be offered digital extracts from the digital topographic model and digital mapping model that may be used independently or together with their own specialist information (see: Figure 1).

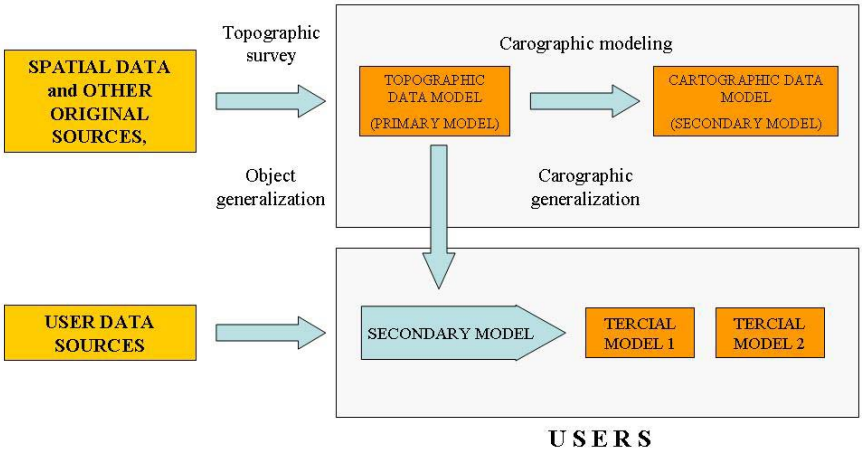

Figure 1: Basic Concept of STOKIS

In order to have the object divided into object types, a catalogue of object types is prepared, In order to have each mapping type associated with the corresponding mapping symbol, a catalogue of signatures is produced (see: Figure 2)

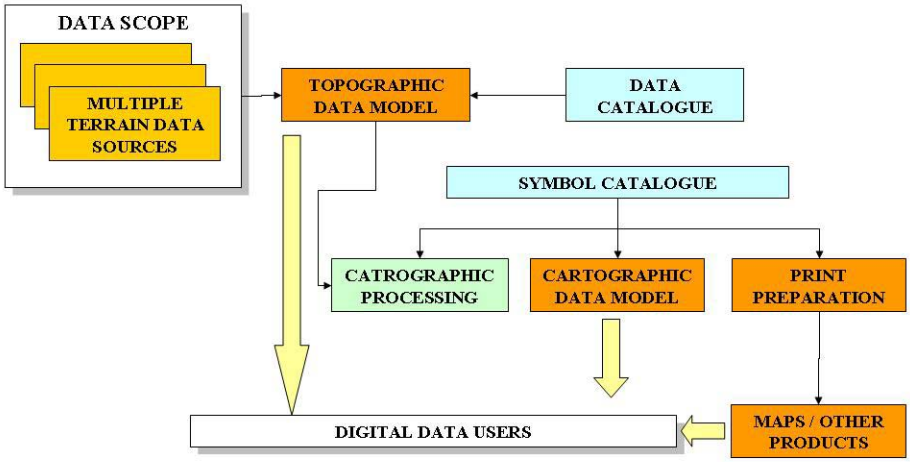

Figure 2: Formation of STOKIS

3.2 Topographic and Information System of the Republic of Croatia - CROTIS

The CROTIS Project is certainly the most important project in the implementation of the official topographic and mapping information system. CROTIS, as the basis for the topographic and information system, primarily aims at establishing the standards and

principles for modelling the graphical and alphanumerical code system for defining, structuring, substituting, coding, transforming and transferring the topographic data.
Its establishment ensured the involvement of the objects that constitute the topographic system in a single data model.
The basic precondition when modelling was to give all the objects, having greater importance for the spatial exploitation and space management, more weight during the collection and presentation. The project was implemented with the establishment of the object-oriented basic topographical database (BTDB) in 2002. The data contained in the BTDB is the topologically processed original data of the photogrammetric restitution, and represents the most accurate and detailed data created during the production of the topographic map in the scale of 1:25,000, (see: Figure 3).

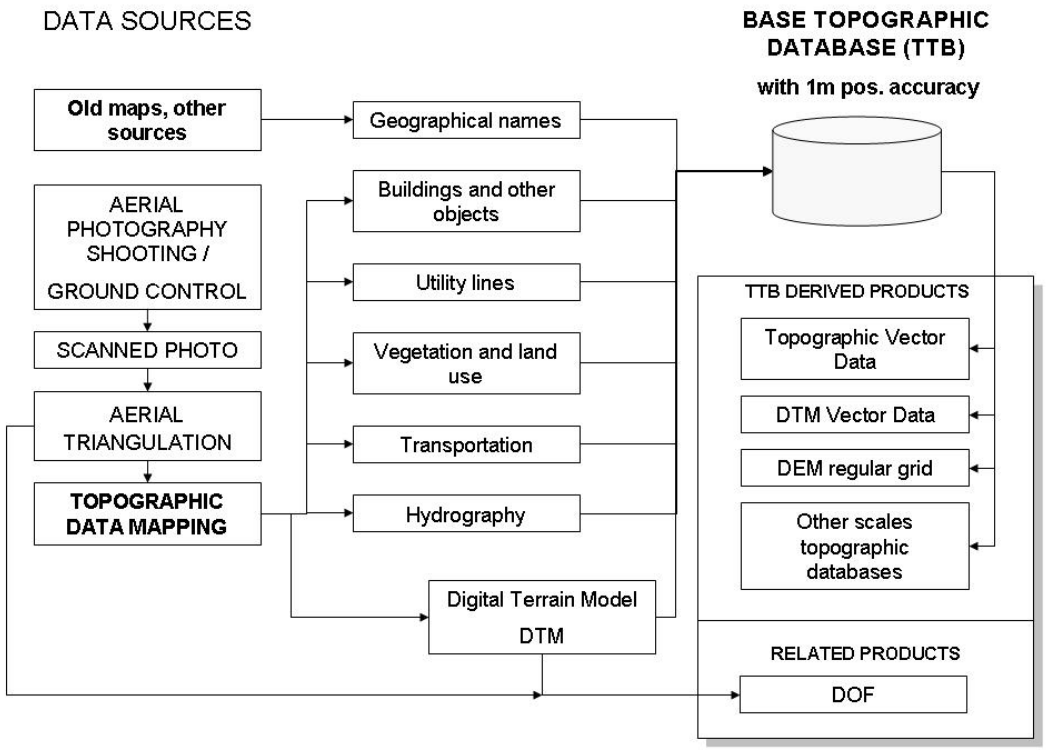

Figure 3: Basic Concept of CROTIS

3.3 Product specification in the official RoC topography

The map production (planned and organized by the SGA) has been entirely conveyed to private companies. Therefore, it was inevitable to describe all the technological processes that a prospective contractor needs to implement.
In the late 2001, the first in a series of technical assistance projects was initiated in the field of geodesy, mapping and cadastre between the Norwegian Mapping Authority (Statens kartverk) on the Norwegian side, and the SGA and CGI as its Croatian

counterpart, that started the implementation of the jointly funded project aimed at improving the establishment of the mapping and topographic map databases in Croatia. The afore-mentioned project renewed the existing or rather developed a series of new specifications that detailed the stipulated products, the manner of their production and the manner of the quality control implementation. This refers to the specifications of the aerial photography and orientation points for the scanned images, the aerial triangulation for the topographic survey data, the topographic map production itself for the production of the digital ortophoto map and the production of the digital terrain model. These specifications do not refer only to the part performed by the SGA and CGI but also to the procedures of the production and internal quality control of the companies that produce these maps. (Bačić, 2009).

4 The production of the topographic map in the scale of 1:25,000

The basis for the topographic survey in the Republic of Croatia is the aerial photogrammetric surveying in the approximative scale of 1:20,000. The State Geodetic Administration started the cyclical surveying in 1996 by surveying 20% of the RoC territory every year. For the photographs obtained by the aerial photogrammetry, aerial triangulation is being performed, followed by the restitution conducted by analogue and digital stereo instruments. The mapping has been defined by the CROTIS data model.
The objects encompassed by the data model have been classified with regards to their form, position and topological relationships in object categories, groups and types. The attributes that are being closely defined are being associated with these types. The object type is a designation for the objects encompassed by the model. The object group consists of several types that can be grouped based on common characteristics. The object category is comprised of object groups that may be encompassed in one whole given their significance.
According to the data catalogue (Product Specification for Topographic Data, version 1,2 SGA), the topographic data is divided into 6 object categories, 26 object groups and 79 object types (2D) while the data for the production of the DTM (3D) is divided into 4 object categories, 7 object groups and 27 object types, see: Figure 4.

FEATURE CATEGORY	FEATURE GROUP	FEATURE CLASS
1000 GEOGRAPHICAL NAMES (TOPONYMES)	1100 Names of geographic entities	1101 Territory (region), field, fields area boundary
	1200 Names of land relief forms	1201 Mountain, mountain chain, foothill region
		1202 Pass, valley, cliff, ravine, ridge, slope
		1203 Peak, saddle, rock
	1300 Names of inland waters and seas	1301 Gulf, cove, cape
		1302 Sea region
	1400 Names of islands, cliffs and reefs	1401 Island
		1402 Cliff, reef and shallow spot
	1500 Names of settlements	1501 Settlements and villages
2000 BUILDINGS AND OTHER OBJECTS	2100 Residential and public buildings	2101 Civil objects
		2102 Administration, justice and finance affairs buildings
		2103 Health and social protection buildings
		2104 Culture, science and education buildings
		2105 Sport and leisure buildings
		2107 Ruins
	2200 Commercial buildings	2201 Industrial buildings
		2202 Energetic buildings
		2203 Farming buildings
		2204 Trade, tourism and catering buildings
		2205 Road traffic buildings
		2206 Railway traffic buildings
		2207 Air traffic buildings
	2300 Religious and cultural-historical buildings	2301 Religious buildings
		2302 Cultural and historical objects
	Other buildings	Special purpose buildings
		Other buildings
	2400 Other objects	2401 Embankment

Figure 4: Overview of a segment of the data catalogue from the Specifications

The data that are being collected had to contain in the geometric sense only points and polylines. The data collection for the topographic information system consists of several stages. The first and most important stage involves the data collection on the space geometry and the objects in space. All the data that will eventually be uploaded in the topographic base must be mapped according to the stipulated mapping catalogue. The next stage is to collect the descriptive data on the illustrated objects that are provided for by attributes of each object type by the conceptual data model. The mapping catalogue connects each object stored in the exit database (that must be attributed) and the corresponding table into a base of attribute data. In such a way, it is ensured that all attributes in the tables possess only the allowed values. However, this does not mean that the quality control will not contain also the control and value of the attributes. The base of attribute data is an auxiliary database created in the process of processing the data to be stored in the basic topographic database.

One base of attribute data with the filled-in attribute values needs to be used for each package of four CAD database.

The databases ordered in such a way are being forwarded for a check to the Croatian Geodetic Institute)CGI) that, after the quality control performed on the submitted data, converts them in the format fit for being uploaded into the basic topographic database (ORACLE).

After a successfully performed quality control, the contractors carry out the processes of the model and mapping generalization in order to obtain the end product which is the topographic map in the scale of 1:25,000

All production processes required for the production of such type of products are described in the Product Specifications.

The entire process of the map production, ranging from contracting to final delivery, ends with the official launch of the products. This action puts all the previous product versions out of official use, whereby they acquire the archiving status.
In the past 12 years, enormous efforts have been invested in topographic backgrounds so that, until now, the total of 586 sheets out of 594 sheets have been produced and put in official use or the production contracted, while 8 sheets remain to be contracted in 2009. (See: Figure 5).

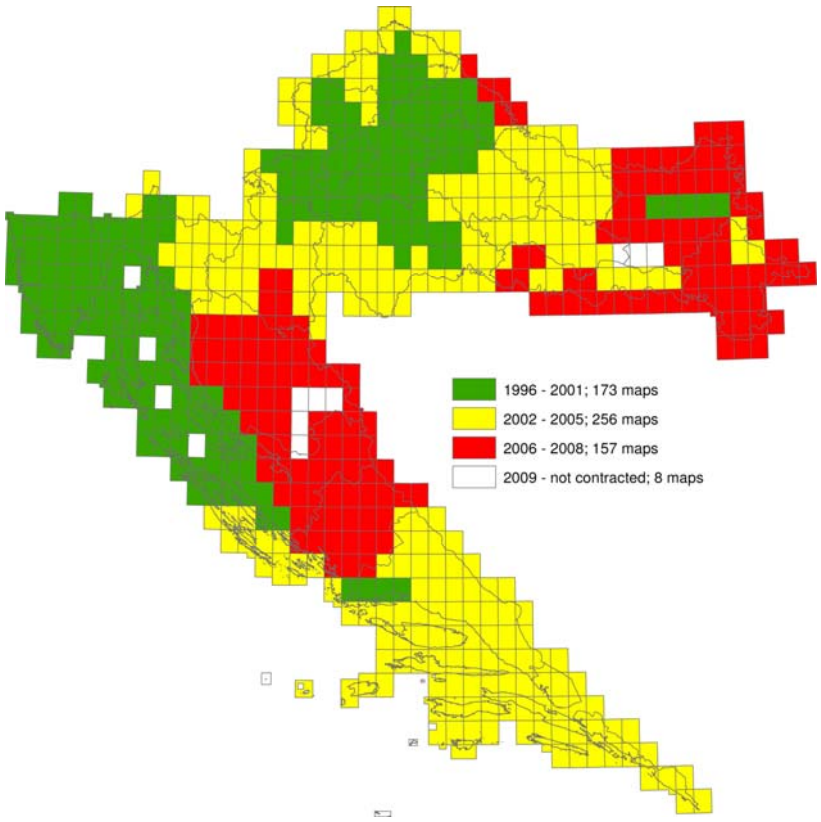

Figure 5. Overview of the TM25 sheet production by year

5 Conclusion

Today, spatial information are becoming the product that is used or demanded by a great number of users on a daily basis. This used to refer to maps in various scales in analogue form while today this refers to spatial data in digital format used in various ways with the help of new technological aids and becoming an important factor for the development of the entire economy of any county.
In this respect, the SGA has the legal obligation to promote spatial information in a form acceptable to all potential users. Furthermore, the SGA is becoming an open

institution geared with the needs of the market and providing support and developing the products that can satisfy even the most demanding users.

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