DETAILED QUALITY CONTROL OF TOPOGRAPHIC MAP IN SCALE 1:25000

Authors: Slavko Lemajić*, Branko Puceković**, Tomislav Bašić***
*Croatian Geodetic Institute, Savska 41/XVI, Zagreb, Croatia
slavko.lemajic@cgi.hr,
**Croatian Geodetic Institute, Savska 41/XVI, Zagreb, Croatia
branko.pucekovic@cgi.hr,
***Croatian Geodetic Institute, Savska 41/XVI, Zagreb, Croatia
tomislav.basic@cgi.hr

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ABSTRACT

This Paper is describing production of topographic map in scale 1:25000 in Croatia according to the Product specification. At the beginning of production was made on different documents describing several phases of production. Croatian norwegian geoinformation project had the goal to collect all relevant documents and make specification on ISO base. Also, the goal of project was to establish quality control system in Croatian geodetic institute. The quality control established in Croatian Geodetic Institute ensure that final product fulfill Product specification. Quality elements are defined on ISO base and there is accepted 95% confidence level of quality.

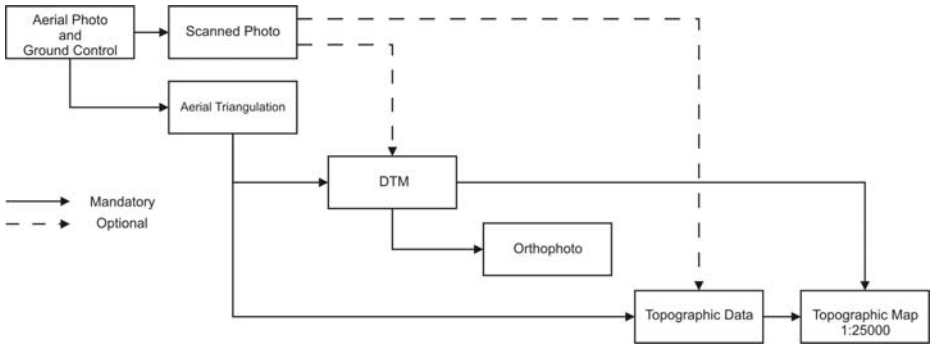
1 INTRODUCTION

State Geodetic Administration started with production of new topographic map in scale 1:25000 started in 1997. One of important study of current status and proposals was performed in 1995 for substitution of films of old topographic maps. The result was the production of part of topographic maps in scale 1:25000 Rakov Potok. Those study result with evaluation of existing military maps and recommendations for new production. In continuation cooperation with private sector finished with basic documentation that designates vision and goals, while through studies and pilot projects they developed procedures and exact steps for realization of the goals. The production of TK25 (Topographic map in scale 1:25000) phase was commended to the private geodetic companies in public and open tenders. Since 2002 Quality control of topographic maps inflicted to CGI and the process of control had different phases.

2 OBJECTIVES

The Quality Control system in 2002 was based on full-QC system; the whole territory of TK25 (one map sheet) was controlled and according to that system result was with enormous number of remarks. The lack of quality control in production by private companies forced to use such system.

Slowness of that system drawn to change and implementation of sample based QC system but results of detailed control forced private companies to improve their processes of production. For different purposes and users full control method is still acceptable and in this case confidence level of quality is better than 95%.
Different guidelines for production of TK25 at the beginning were produced. Some of most important are mapping catalogue, Cartographic Key and Rules for Map Generalization. The main documents covering topographic survey was Book of Ordinances for topographic survey and map production (2001) and Croatian Topographic and Cartographic Information system – CROTIS (2000) which is actually base for Topographic database.
In 2002 started Croatian Norwegian Geoinformation Project (CRONO GIP) with main objective to create a new QC system based on ISO standards and sampling methods and to create Topographic database in SGA based on CROTIS model. The result was QC documentation with general documents (basic principles, guidelines for sampling), procedures for control of quality elements and practical check lists. The approved confidence level in this case for QC is 95%. Also, the result of CRONO GIP was a set of Specifications: Aerial Photography and Ground Control Points, Scanned Photos, Aerial Triangulation, Digital Terrain Model, Orthophoto, Topographic Data and Topographic map in scale 1:25000 (TK25).
Each of the Products serves as the predecessor for the following production phase so that each company can be in state to undertake and to precede the job from any other company. Two "main" products are needed for production of Topographic map in scale 1:25000: Topographic Data (TD) and Digital Terrain Model (DTM) and for their production, the Aerial Triangulation is the predecessor (Rapaić, 2004). It is planned that each production step in form of the Product will have to be quality controlled and approved before further usage (Picture 1).



Picture 1: Topographic production

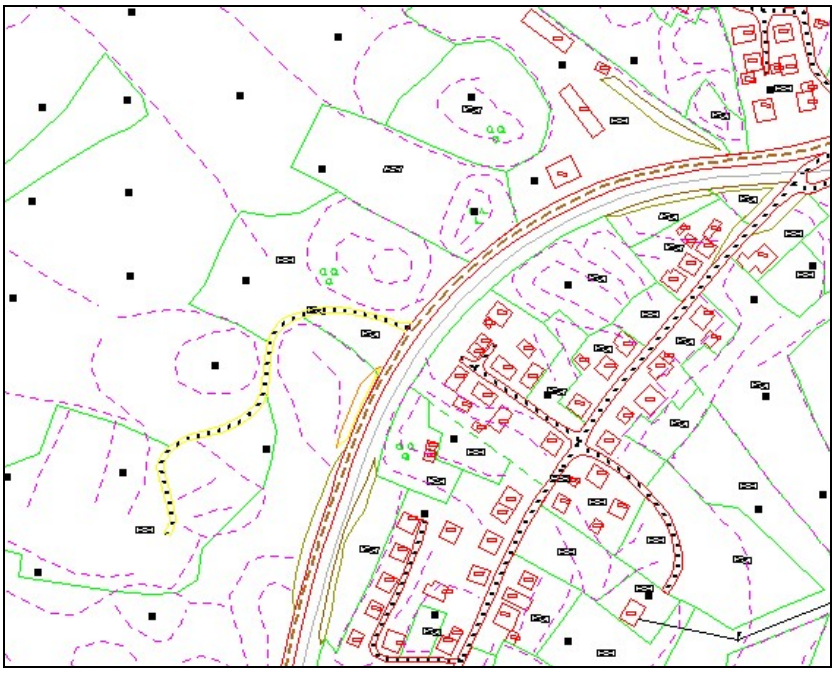
The whole territory of RH is covered with 594 map sheets in scale 1:25000 according to the official map sheet nomenclature published by SGA.
Specification for TK25 (version 1.1) is covering following issues (SGA, 2004):

- Introduction
- Terminology and Abbreviations
- Document Background
- Purpose

- General Information
- Superior Requirements
- Deliverables
- Cartographic Generalisation
- Cartographic Representation
- Printing
- Specific Requirement
- Quality control Tolerances
- Appendices (Delivery List, Production Report Requirement, Map Sheet Nomenclature and Names, Cartographic Generalization, Cartographic Key, Settlement Names, Guidelines for Toponyms and Report Tables)

3 PRODUCTION AND QUALITY CONTROL

The Production of TK25 is done according to the Topographic data (TD) and according to the digital terrain model data (DTM) as shown on Picture 1 using procedures described in Product specification for TK25. Example of source data (Topographic data and digital terrain model) is shown on Picture2.



Picture 2: Topographic data and DTM

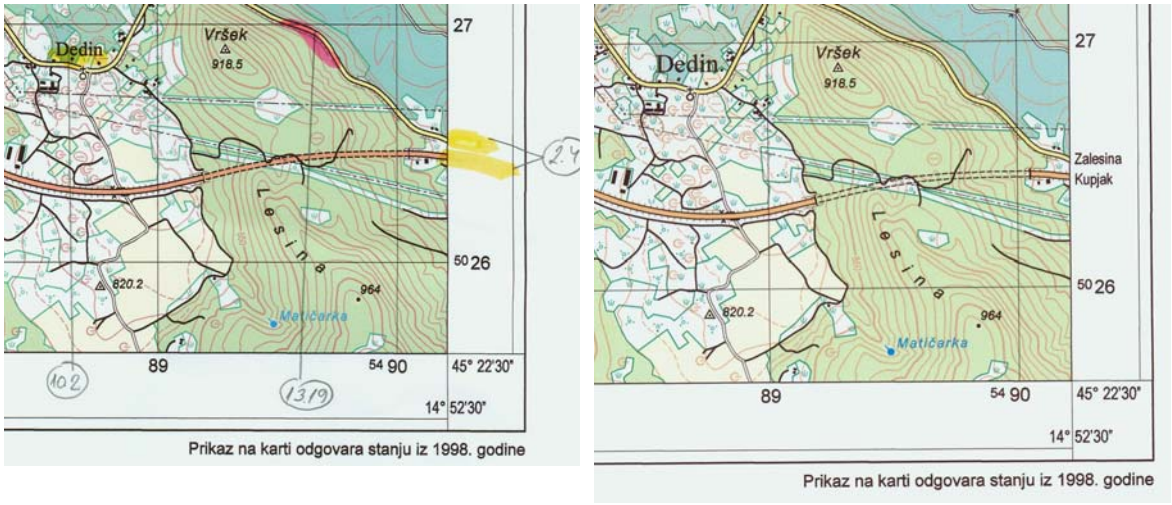
Combining the procedures from Product specification and best practice experiences quality elements are (CGI, 2004):

- Overview
  - Configuration
    - That all items are delivered
    - Readability of digital media
  - History

        - Approval of predecessors
    - Reporting
        - Producer's information about hardware/software brands, calibrations, certificates, licenses
- Completeness
    - Commission
        - Excessive objects
    - Omission
        - Check omissions for all objects in relation to Topographic data and exclude omissions caused by generalization
- Logical Consistency
    - Format Consistency
        - That correct file-naming conventions are used
        - Verify correct format for raster and postscript files
        - Display Final Cartographic Vector Data files
- Spatial Characteristics
    - Mission Matrix
        - Frame
- Printed Map Characteristics
    - Printing Color Characteristics
        - Films, Test Print and Printed Map, measurements by densitometer
    - Paper Characteristics
        - Printed map, type of paper, thickness
- Printing Film Characteristics
    - Film Characteristics
        - Films
- Map Characteristics
    - Cartographic Key Consistency
        - Printed maps, raster files
    - Generalization
        - Printed maps, raster files
- Positional accuracy
    - Relative Accuracy
        - Contour lines

That also means that quality element positional accuracy will not be controlled on TK25 because positional accuracy was controlled in previous process i.e. on vector topographic data.
According to QC documentation (CGI, 2004) several quality methods could be used: full manual, full automatic or sample manual. By controlling TK25 the most comprehensive method is full manual.
Feature objects and quality elements controlled by CGI contain in practice: map frame and coordinate grid, map description, trigonometric points (according to the official database and compatibility with relief), relief review, check of settlements (spatial units registry), objects and utility (according to the TD, generalization), hydrography (objects, type of waters, compatibility with relief, generalization), traffic (categorization, objects,

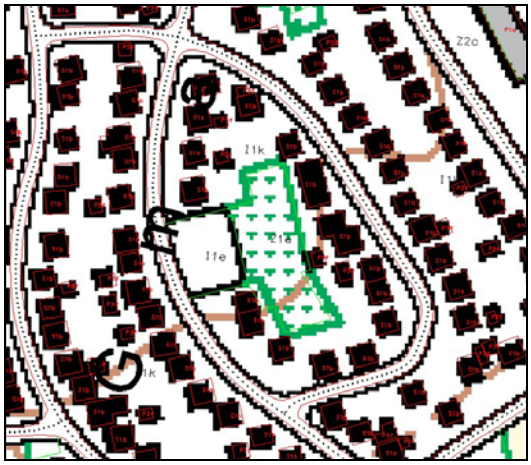
generalization), land cover and land types, check of toponyms (according to the sources), edge matching, field checking (check with reality, accuracy) and general alignment of topographic symbols with cartographic key (Specification) including standardization of different producers.
The process of QC consists of some few phases, in first phase QC in office and checking in the field (Picture 3), second phase consists of QC of bug fixes and evaluation for last phase i.e. production of films and test prints. In last (third) phase subject of QC is testing of quality of films, test prints and final data (vector data, raster and post script).



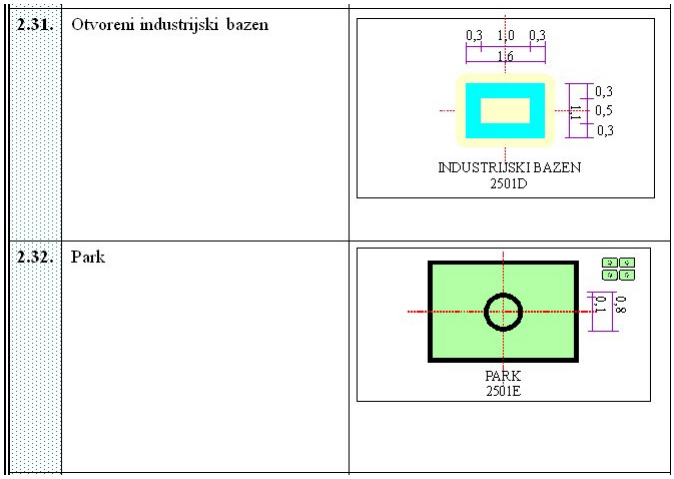
Picture 3: Examples on remarks and corrections

While checking map generalization the controller should use source topographic data and compare them with topographic map (Picture 5). For control of map generalization is recommended to use source data (topographic vector data) and orthophoto map (Picture 4) if produced from source photography.


Picture 4: Control source data


Picture 5: Control Map Generalization

When used full control method in first phase of production time of control was very long and number of remarks too big. By using sampling methods period of time was reduced and obligation of producer was to correct remarks in sample and in all other parts of map. Each correction should be documented and controllers checked corrections outside sample.
While checking the map in office and in the field controllers are trying to follow objective approach of control as well as written rules in quality documentations.
Field control was carried out on map user level. Two users (controlers) are driving by car thru the map and trying comparing the map with situation in terrain and in addition in the field controller is taking photos as documentation for correct remarks. Remarks are marking on map in two colors, yellow for office work and red for field work (Picture 3).
Final product i.e. Topographic map in scale 1:25000 consist of several files and print. Producer of TK25 in final phase deliveries the map in cad format (as used in production, like "dwg" or "dgn" file), raster georeferenced file in "tif" format, post script "eps" separated files for each color (cyan, magenta, yellow and black) and map in "*pdf*" format. Final control is more oriented on checking data formats, specified colors (on printed map and digital raster file), control of cartographic signatures where signatures must be identical as in cartographic key (Picture 6).



Picture 6: Cartographic Key

Percentages of gray tones in postscript files (for each CMYK value) are shown on table 1. Deviations are possible depending on raster interval on film: for interval 10 – 30 % tolerance is ± 2 %, for 35 – 65 % ± 4 % and for interval > 70 % deviation may be ± 6 %.
Each color on map has according to the Cartographic Key exact percentage of red, green or blue value. Indexed colors in raster file should be exactly the same as in template (Picture 8).

Color name	Features	C	M	Y	K
Black	Line features, signatures and toponyms	-	-	-	100%
Dark gray	Rocks, stones	-	-	-	50%

Green	Line features and vegetation signatures.	100%	-	100%	-
Dark yellow	County and local roads	-	-	60%	-
Red	State border	-	80%	50%	-

Table 1: Raster intervals in postscript files

Index	Colour	R(%)	G(%)	B(%)
1	Black	0	0	0
3	Dark grey	150	150	150
8	Green	0	170	90
13	Dark yellow	255	245	140
15	Red	240	100	110

Picture 8: Colors in raster file (and on printed map)

When last phase of control (postscript files, tif files, prints) is finished and results are positive i.e. map is produced according to the Specification, the final report from Institute consist recommendation for official usage.

4 RESULTS AND CONCLUSIONS

After Quality control process in CGI is finished the main step after that is proposal to put map in official usage. Institute's work resulted with more than 400 maps got official status. Production and control of remaining Topographic maps is still in progress. Experiences collected during last year's enabled to improve implemented documents (product specifications) and technology procedures to avoid unnecessary sub products like postscript analogue films. Next phase of production of Topographic maps in Croatia will be based on first edition of maps. Process of maintenance of maps should be done in a parallel way for topographic data (CROTIS database) and for Topographic maps but according to the new map sheet nomenclature and in new map projection based on new positional and vertical datum. The mail goal of systematic approach of planning, production, controlling is establishment of spatial data infrastructure (Lemajić, 2008) whose part will be and Topographic map.

Literature:

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