QUALITY CONTROL ROLE IN PROCESS OF ESTABLISHMENT OF NSDI

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ABSTRACT:

The establishment of the Croatian National Spatial Data Infrastructure has started at the beginning of the 1990's. The main agitator of the activities was the State Geodetic Administration of the Republic of Croatia. They started to build the documentation that describe vision and goals, while through studies and pilot projects they developed procedures and exact steps for realization of the goals. SGA by definition and its internal structure does not have production capacities. The production phase is commended to the private geodetic companies in public and open tenders. The specific triangle was completed through foundation of Croatian Geodetic Institute (CGI) according to the Law on state survey and real estate (NN, 1999). Since 2001 when Quality Control started CGI gave active support on improvement of geodetic products, topographic maps, topographic vector data, digital terrain model and orthophoto. Some of these products are included in first Croatian Geoportal.

1. INTRODUCTION

One of the basic tasks in creation of national spatial data infrastructure (NSDI) is production of spatial data to cover the whole territory of Croatia.
The production of geodetic products is organized on specific way, the policy plans and budget is in hands of State Geodetic Administration (SGA, Figure 1.). Through cooperation with academic society and some private companies SGA established necessary documentation for data production. Private companies are included into open tenders for data production and independent Quality control process was established in Croatian Geodetic Institute to ensure the accurate data according to the Product Specifications that serves as a standard in production processes. Some improvements of specifications were made 2002-2004 by Croatian Norwegian Geoiformation Project (CRONO GIP) to follow International standards (ISO). In this paper is described purpose and role of QC system for establishment of Geoportal as system with main geoinformations for NSDI.

2. ACTIVITIES ON NATIONAL SPATIAL DATA INFRASTRUCTURE ESTABLISHMENT

2.1 Preparation activities

The first predecessor activities on NSDI establishment in Croatia can be found in late 1990's. In 1999 Croatian Parliament accepted the Law on State Survey and Real Estate Cadastre which defined founding of public institutions for state survey and real estate cadastre works - Croatian Geodetic Institute (CGI). One of the main tasks of CGI was quality control of SGA's data. In continuation to the mentioned Law in 2001 the Book of ordinance for topographic survey manner and state maps production was adapted. Trough those regulations official status of SGA's data, actively topographic data and state maps was defined. State survey data that include also topographic data and state maps get official status after passing quality control process. Such data can be used for different purposes, especially for works and fulfilment tasks on state level.
Therefore, adopting of Programme of State Survey and Real Estate Cadastre for the period 2001-2005 lunched significant production of several datasets. The holder of the Programme was the SGA. The SGA made a huge number of agreements with public institutions and regional and local self-government bodies in order to assure funds for data production that was outsourced to the private sector. The SGA has been also responsible for regulations, so the production model established in 2001 is shown in Figure 1 and was one of the first SDI principles.

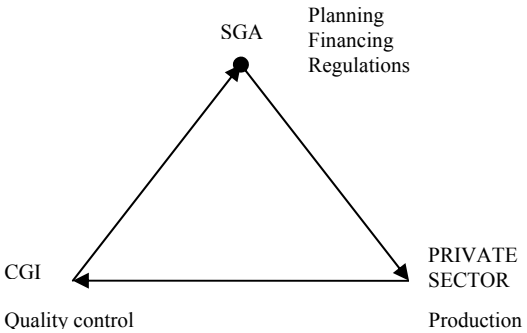

Figure 1. "Triangle" data production model

First activities on the operational level can be seen in establishment on CROatian Topographic Information System (CROTIS) that started in 1996. In year 2002 CROTIS data model was approved by SGA and framework for production of digital topographic database was established. Trough CROTIS project standardization of topographic spatial data is comprised, that gives main and detailed solutions of topographic spatial system in domain of data model, their collecting, processing, accuracy, way of presentation, topologic relations and their interchange. After CROTIS a set of product specification were produced. The whole production work is covered by seven

Product specifications: Aerial Photography and Ground Control, Scanned Photos, Aerial Triangulation, Digital Terrain Model, Orthophoto, Topographic data and Topographic Map in scale 1:25000 (TK25). After spatial data delivery finished the process of quality control in CGI can start according to implemented rules. Quality control documentation includes general documents (basic principles, guidelines for sampling), description of quality elements and sub-elements and check list for performing control. CROTIS and product specification are the base regulations for data production and above mentioned quality control process.

2.2 Legal framework for SDI establishment

In February 2007 the new Law on State Survey and Real Estate Cadastre (further: Law) entered into force. A novelty was a new chapter on SDI that gives definition of NSDI in Croatia. Metadata, content of metadata information, services, NSDI data and subjects that are obliged to participate in its establishment and maintenance, are defined and what is very important the Law gives institutional framework for NSDI establishment.

According to the Law SDI body on the highest level is NSDI Council consisting of 15 members, representatives of different ministries and other state bodies, relevant scientific institutes, economy and profession. On the managerial level there is NSDI Committee consisting of two representatives from SGA, three from NSDI Council and heads of working groups. On the operational level there are working groups and special interests groups. SGA acts as coordination body responsible for coordination and technical support. SGA is also obliged to establish a national geoportal with metadata services for all NSDI data defined trough the Law.

3. BUILDING NATIONAL GEOPORTAL

SGA has set general goals of implementing information technology. According to this vision, SGA has a key role in collecting and processing of spatial data in the present and will play a major role in organizing those data in a way that will enable their distribution to the end users in a friendly and easy-to-use manner in the future.

At the same time of preparing the Law SGA launched a project for establishing of SGA's geoportal. This project realizes organizing spatial data and their distribution, i.e. user access over the Internet. Main objective of this project is design, development and implementation of information system for sales of products, services and information from SGA's existing and future geospatial data portfolio over World Wide Web to various types of customers. The main objective of the Geoportal itself is to establish the Publish-Find-Bind pattern for SGA and other providers offered geospatial resources. Resources in that sense are of the following:

- Geospatial datasets (data-products)
- Geo Web Services
- (Web-)Applications and other undefined resources.

The Geoportal offers a metadata-driven catalogue-service for publish-and-find functionality. The catalogue contains metadata descriptions of all resources and allows users and other applications/portals to query and find these resources. Once a resource is found, the Geoportal aids the user in the evaluation-process by presenting the metadata in a user-friendly way. The metadata records are also accessible for engine-to-engine access in a standardized ISO-based structure. One of the key-objectives of this project is to establish the ordering-process (www-sales) for SGA´s geospatial data products.

In the first phase of SGA geoportal development five databases are included, creating functionalities among them, data distribution system through the Internet. Scanned Croatian base map at the scale 1:5000, digital ortophoto maps at the scale 1:5000 and scanned cadastral maps in various scales will be available on geoportal in the first phase. It will also realize links to existing databases of central register of spatial units and database of permanent geodetic control points. SGA's geoportal is the first approach to the national geoportal and will be in function middle 2008.

In comparison of Inspire Annexes I and II with NSDI data defined trough the Law, it is visible that a significant number of spatial data themes are under SGA responsibility. Consequently, only data that have passed quality control process will be available on geoportal, at the moment SGA's geoportal and in the future national one. SGA will assure a set of data under its responsibility easily accessible on geoportal, and what is important to stress there are official data with assured quality, according to the adapted regulation for state survey and cadastre data (figure 2).

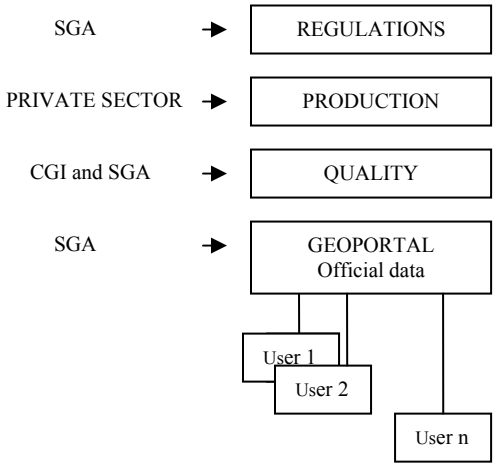

Figure 2. Official state survey and cadastre data on geoportal

One of the main tasks of the SGA is to cover the whole territory with spatial state survey and cadastre data and to make data with assured quality available and easily accessible to the whole community. This principle will avoid duplication of data production what is one of the main Inspire principles. In the first phase of this Geoportal SGA becomes a Croatian provider of basic services to easily register, execute and integrate external (standardized) GI-Services across the Internet and SGA Geoportal becomes the first national Geoportal, accessible by the whole Croatian GI-Community (consumers and providers).

According to the Law, SGA is obliged to establish also metadata service for other NSDI data that are not under SGA responsibility, till 2010. SGA geoportal will be the base for national geoportal which will follow Inspire implementing rules for metadata (Figure 3). In continuation is given an overview of Quality Control on Orthophoto example.

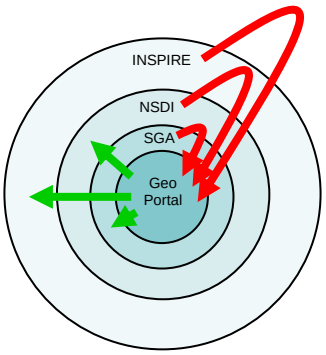

Figure 3. Geoportal in relation with NSDI and Inspire

4. ORTHOPHOTO PRODUCTION

Production of orthophoto is based on Product Specification (SGA, 2003) which describes all important issues. Some predecessors are also important to product orthophoto (Scanned Photos if applicable or digital aerial images, DTM and Aerial Triangulation) i.e. for correct orthophoto the condition is that previous products passed on Quality Control. The Figure 4 shows the hole system of products and previous products which are documented through CRONO GIP.

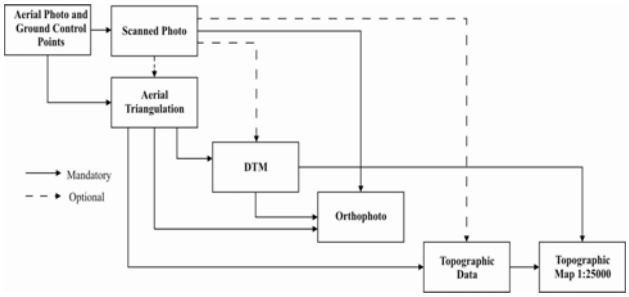

Figure 4. Products and products' predecessors

The initiate Orthophoto production was based on gray scale aerial photography and first Product specification described gray scale orthophoto. The final orthophotos shall have a radiometric resolution of 8 bits; 256 grey levels. The distribution of the histogram shall be approximately between 5 (black) to 250 (white). Changes in the product specification are based on user needs and on new technology methods and processes. The latest Product specification describe color product (24 bit colour raster). The delivery consists of delivery list, production report and data (raster data, vector frame and toponyms data and orthophoto print). Specification for Orthophoto Production (SGA, 2003a) consist od description of Images used for Orthophoto production, way of Image rectification, mosaicing, retouch. Also there is described the way how to collect and represent vector data (toponyms) and draw map frames. Main parts of Product Specification are also appendices: Delivery List Requirements, Maps Sheet Nomenclature, Cartographic Key for Toponyms and Official gazetteers for public roads and settlements.
The accuracy of final Orthophoto should have standard deviation of 1 meter (for well defined objects).

5. QUALITY CONTROL SYSTEM

Quality control system is based to fulfill 95% confidence level for delivered data. The whole QC system includes documentation (general documents, guidelines for QC and check list), human recourses and equipment (software, hardware and professional devices). General principles are described in Quality Control Principles of Geographic Information (CGI, 2004b). General principle of methos are shown on Figure 5. All the data needed to perform an internal direct data quality evaluation method is internal to the dataset being evaluated, e.g. controls by means of software. External direct quality evaluation requires reference data external to the dataset being tested, e.g. check against other data.

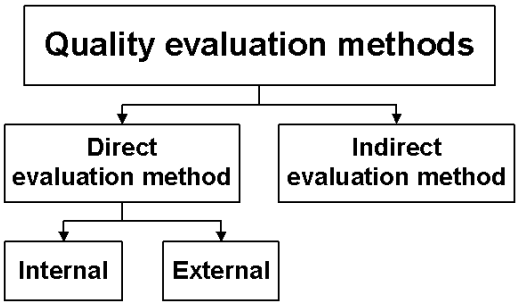

Figure 5. Quality evaluation methods

QC Process includes determination of quality plan and quality methods, executing and reporting. Concrete quality plan means defining dataset, identification quality elements and subelements and tolerances, control methods, acceptable level of quality and way of reporting.
The Quality Plan is developed according to definitions of ISO quality elements, subelements, descriptors, evaluation methods and selected tolerances (ISO, 2001).
Execution of the Quality Plan on Spatial data results with the Quality Evaluation Reports with information about dataset, used quality elements, executed measurements i. e. controls, tolerances according to specification, used methods - full control or sampling (CGI 2004c), used equipment or software, processing of measurements, comparing results with tolerances and finaly quality evaluation of product delivery (product is acceptable or not).
Quality elements and subelements used for spatial data quality control are used according to Product Specification (State Geodetic Administration) and described in separated document.
The process of quality control procedures can be divided in four classes depending of the control type used: manual full (MF), automatic full (AF), manual sample (MS) and automatic sample (AS).
In praxis the quality control process includes: control of delivery, execution of control (manual, sampling or automated) and reporting.
The Quality control result is described in Evaluation Report and possible result can be that product is accepted or rejected. Final product should be after corrections accepted and officially approved.

6. ORTHOPHOTO QUALITY ELEMENTS

After spatial data production and delivery finished the process of Quality Control in Croatian Geodetic Institute can start according to implemented rules.
Orthophoto production is described in Specification (SGA, 2004) as well as final delivered product. Specification consists of guidelines for delivery orthophoto product and

documentation from the process of production. From Specification clearly come out Quality elements and subelements (CGI, 2004a) that are subject of Quality control. The list of Quality Elements (QE) contains: Overview, Spatial Characteristics, Completeness, Logical Consistency and Positional Accuracy.

All QE are further divided into subelements:

- Overview
  - Configuration
  - History
  - HW an SW Description and Production report
- Spatial Characteristics
  - Orthophoto Characteristics
  - Frame characteristics
  - Mission Metrix (location)
- Completeness
  - Commission
  - Omission (missing photos or toponyms and road names)
  - Completeness of Toponyms and Road Names
- Logical Consistency
  - Format Consistency (files can be opened and viewed, file names and formats, correctness)
- Positional Accuracy
  - Absolute Accuracy

Using appropriate software and prepared spreadsheets in excel format controller is performing quality control.

The main condition for further controls is passed control of delivery. There is no sampling method used for this control. The criteria are that corrupt or missing deliverables is not acceptable. In this process should be checked received material against the delivery list, present all deliverables in delivery and check that all data files are readable. The principle is if this first control not passed the product and whole delivery should be rejected before next detailed controls. If delivery passed on control further controls can be perform. Because of system of predecessors controller should check if results of previous QC of predecessor products passed on control (Scanned photo, Aerial Triangulation and DTM). In Production report should be inspect description of used software and hardware to finish control of overview quality element. Control of subelement Orthophoto characteristics contains check geometric resolution, radiometric resolution and distribution of histogram. For gray scale orthophotos distribution of histogram shall be approximately between 5 (black) and 250 (white). The values 0-5 and 250-255 are not allowed. Similar situation is also with RGB colour orthophotos and distribution of each channel (red, green and blue). Check of location (origin, dimensions and resolution – Figure 6) each orthophoto should passed 100 %. Appropriate method for that control is fully automated.

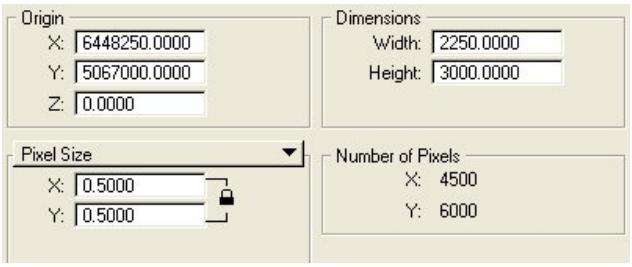

Figure 4. Control of origin, dimensions and resolution of orthophoto image

According to Contract for production data full area should be covered with orthophotos (excess and missing are not allowed).

Inspection of Toponyms and Road Numbers (Figure 5) as cartographic part of orthophoto product (see Figure) check according to official sources like Croatian Base Map in scale 1:5000 (check of toponyms) and classification of public roads (road numbers).

Figure 6. Toponyms and Road Numbers on Orthophoto

Positional accuracy and their sublement absolute accuracy control by field control method. Objects in the field are measured using GPS, and this true position (e.g. road boundaries) is used to control the accuracy of the Orthophoto (Figure 7).

Figure 7. True position (road boundaries) on Orthophoto

The standard deviation for accuracy is calculated for the observations and accepts or rejects criteria is determinate for each of them using statistical methods described in documentation. Orthophoto accuracy should only be controlled on good visible objects.

7. CONCLUSION

Production of spatial data is still in progress, first experiences enabled to improve implemented documents and technology procedures. Very important part in the cycle of improvement lies on the Croatian Geodetic Institute that controls most of the geodetic Products and their role is to evaluate the Products and its Specification in the same time. It has to be pointed out that the Quality Control System according to ISO norms is in constant process of development and improvement. From NSDI point of view is very important to include into database official and approved data passed on quality control in Croatian

Geodetic Institute. Main reasons in this proposition are users and their needs for accurate data.

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