Integrated Map Authoring and Production Processes in Complex Cartographic Cross-media Projects: The SWISS WORLD ATLAS as an Example

Lorenz Hurni, Roland Schenkel, Christian Häberling, Aline Grötsch

ETH Zurich, Institute of Cartography and Geoinformation, Stefano-Franscini-Platz 5, 8093 Zurich, Switzerland

Abstract. The SWISS WORLD ATLAS (SWA) is the most widely-used atlas for Swiss secondary schools. It is currently being entirely revised by means of digital technologies. This paper provides information about the organization and the workflow of the atlas revision. The automated data processing to create specific map types and atlas parts such as economic maps, city maps, indexes, etc. is described.

Keywords: Atlas cartography, school atlases, database cartography, cartographic production workflow.

1. Introduction

The production workflow for maps of all kind has become entirely digitally for almost 20 years. Whereas digital map production in the beginning concentrated on "re-enacting" the traditional map workflow by digital means for attaining mainly the same level of graphical quality, the production chain has now entirely changed. Many source data-sets are available as databases and the cartographic processing is very often limited to the application of proper symbols/styles and maybe some geometric editing; this is especially true for many online-applications, but also for printed map derivatives from large vector databases such as Open Street Map. Nevertheless, be it printed or screen maps, the situation arises still very often that insufficient base information is available for a map project; this is especially the case for thematic maps or for maps of up-to-now inadequately mapped territories. In such cases source information of various provenience and on different media must first be consulted, matched, harmonized, and processed. Only then it should be cartographically edited. In classical cartography, the first part, the so-

called map authoring, was very often strictly – also technologically – separated from the cartographic, design-oriented handling. The question now arises whether these two processes can be combined or even closer interweaved in order to speed up the overall processing and to create synergies. For single maps we may assume that this could now be done in a rather efficient way, but the question can be extended to whether frameworks and workflows for large map projects with hundreds of maps and of even very different kind can be defined and developed.

The SWISS WORLD ATLAS (SWA) is the most widely-used atlas for Swiss secondary schools. It exists since 1910 and is a mandate by the Swiss Conference of Cantonal Ministers of Education (EDK). Since 1925 the chair of cartography at the Institute of Cartography and Geoinformation at ETH Zurich is responsible for the editorial work. *Figure 1* shows the covers of the atlas series from 1910 to 2002.

Figure 1. Covers of the SWISS WORLD ATLAS (formerly SWISS SECONDARY SCHOOL ATLAS) from 1910 to 2002.

The printed atlas consists of 400 maps on 192 pages. It is complemented by an interactive version making use of the same map material and cartographic symbolization. The online version is amended by various interactive functionality and additional information. Although the atlas has been entirely converted to digital keeping of data by 2002, the data management and structures are not considered ideal. The maps are individually set up and are stored mainly as graphical files in two different formats with largely neglected topology. Provision is made for the publication of an entirely revised edition of the atlas in 2017. The planned maps cover topics at various scales such as topography, relief, nations, economy (with import/export diagrams), population density, climate (with local diagrams), geology, city areas, and other specific thematic content, including orthophotos and satellite images, profiles and block diagrams.

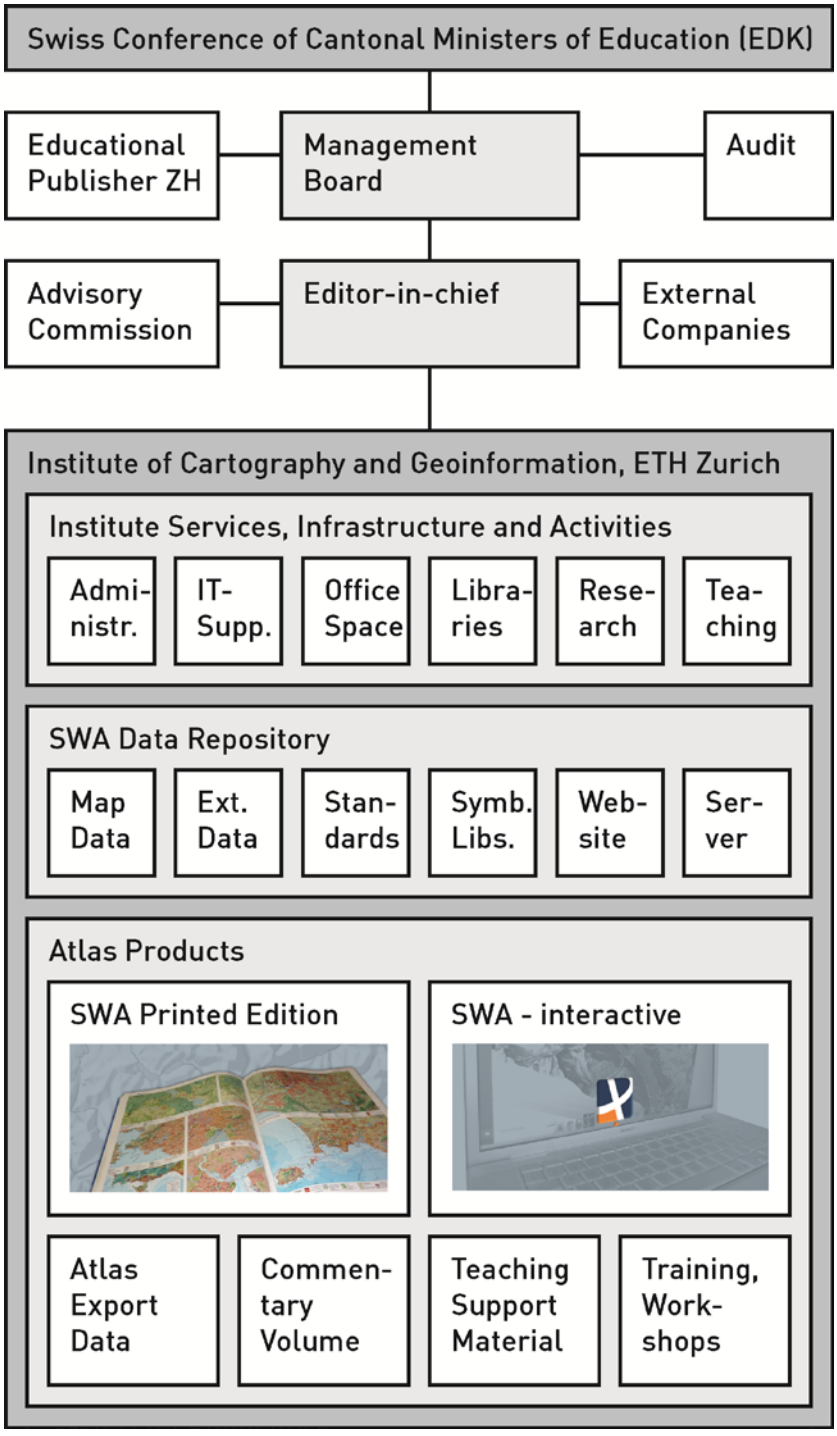

Figure 2. Organisational chart of the SWISS WORLD ATLAS.

In the last few years, a substantially revised framework has been set up which allows for an improved conception, processing and editing of all types of representations of the SWISS WORLD ATLAS. In this paper we first would like to present the novel generic structural components of this framework, which can later be applied to all kind of map products and map compounds. We will then demonstrate the specific implementation for the SWISS WORLD ATLAS.

2. Organisation and General Workflow of the SWISS WORLD ATLAS Project

As said, the atlas is mandated to the Institute of Cartography and Geoinformation by all cantonal ministers of education (*Figure 2*). A management board under the lead of one of the ministers is in charge of steering the project regarding the overall planning, the funding and reporting. The public Educational Publishing House of the Canton of Zurich is in charge of production and distribution. The holder of the chair of cartography at ETH Zurich is the editor-in-chief. Regarding content, he gets support by an external advisory commission, consisting of teachers from different cantons. The main work is carried out by the editorial staff at the institute. Special cartographic work is done by external companies.

There are two main products: The printed version, currently under revision and the main topic of this paper, and the interactive online version (Häberling, Bär, & Hurni, 2013; Häberling & Hurni, 2013), first published in 2010. Furthermore there is a printed commentary volume covering the content of the current atlas version. The interactive version provides the possibility to export base maps in various formats for other projects and educational purposes. The editorial staff also offers training courses for teachers on the use of both atlas versions.

The content-related core of the atlas work is a large data base and file-based data repository which serves for deriving the various atlas products. The different map types, already mentioned in the introduction chapter, are derived from this data collection. Besides the map data, it consists also of external data used for the map production, of defined standards for the layout, the used colour scheme, the text styles), and a library of predefined symbols. The data is stored on an internal server infrastructure. Data which can be accessed by the end users is however stored separately. This external communication is enabled via the official webpage (www.swissworldatlas.ch) in four languages (g/f/i/e). The interactive version of the atlas is linked to the webpage, but resides on another server.

In the following chapter, the structure and main map types of the printed atlas are described in detail regarding aspects of content, source data processing and technical implementation.

3. Structure and Implementation of the Map Types in the printed SWISS WORLD ATLAS

3.1. Synoptic maps and relief maps of countries and regions

Like in the preceding versions of the SWISS WORLD ATLAS, selected countries, parts of continents and continents are covered by synoptic maps at scales 1:800,000 (Switzerland), 1:4 Mio (regions of Europe), 1:15 Mio (Europe) and 1:30 Mio (other continents). They show main cities, transportation network, land cover and a shaded relief. Most of the map data was taken over from the former atlas version of 2002. The original data was either in Macromedia Freehand or Intergraph dgn formats and was then georeferenced using ESRI ArcGIS and Avenza MAPublisher for final use in Adobe Illustrator. It is one of the advantages of the technical implementation that data can be processed using different software without losing information. The same procedure applies for a series of small scale relief maps, where the land use has been replaced by hypsometric tints according to the scale defined by Eduard Imhof (Jenny & Hurni, 2006).

3.2. Economic maps

The economic maps are foreseen to be published in the identical scales and map sections as the synoptic maps. They will be placed next to each other on a double page allowing for better comparison. The existing, mainly point-related symbol maps cannot be reused for the new atlas version, since they represent the state of the late 1990ies. Furthermore, feedback from teachers and students has shown that the current maps are generally overloaded and difficult to be interpreted. The second sector (industry) and especially the first sector (agriculture) are over-pronounced at the cost of the third sector (services) which is underrated. The research process for getting reliable information is too tedious. An entirely new workflow – if possible by use of existing economic databases (Hurni & Wondrak, 2011) – is therefore developed.

In the background, information about agricultural use is provided as area information. The data (Ramankutty, Evan, Monfreda, & Foley, 2008) about the use intensity of cultivated land and pasture (in percentage) with a spatial resolution of 5 arc minutes is treated as bivariate information. Ten classes are defined and coloured in a matrix. The original raster data is then coarsely generalized and serves as area information. By the way, a similar area-based

approach is applied for the population density maps. Based on the list of cities (see *Section 3.7*) selected for the synoptic maps and on statistical data, an economy indicator is derived. The size of the proportional round symbols depicting the economic strength is calculated according to the number of inhabitants and the Gross National Product (GNP) per capita, which is in Europe available on regional (so-called NUTS-3) level. Qualitative information about city wise economic activities, compiled from various sources such as Wikipedia and national statistics, is aggregated in 15 economic branches. They are depicted by smaller point symbols on top of the quantitative proportional circles. Furthermore, point information about raw materials (source: USGS), power production (Enipedia, TU Delft), gas and oilfields and pipelines (Petroleum Economist) is collected and also depicted as symbols. The advantage of the method is the possibility of automating to a large extent. It is also expected that information from Wikipedia can be retrieved automatically, either. *Figure 3* shows an extract of a prototype economic map with the matrix describing the percentage of cultivated land vs. pasture (upper left) and the various point symbols about branches on top.

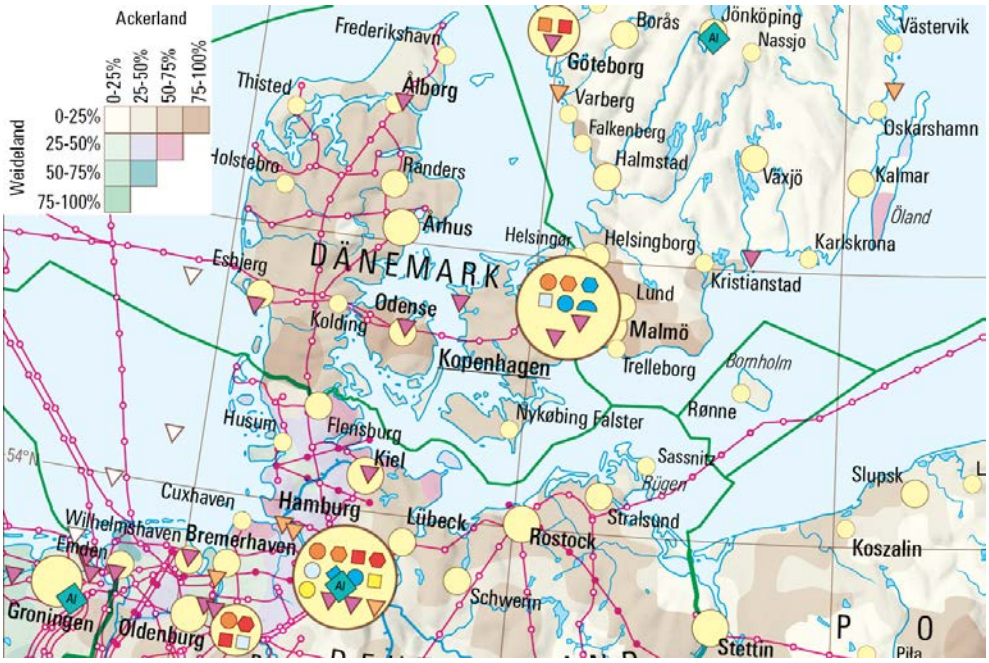

Figure 3. Extract of the prototype economic map, showing northern Europe.

3.3. Political maps

The current atlas is partially lacking political maps fully covering all nations. Due to the high demand expressed by teachers and students, such important maps have been created for all continents and the whole world. The workflow is not very complex. The political map boundaries base on sources like Natural Earth and on the former atlas. The editing is done using Adobe Illustrator. *Figure 4* shows an extract of the prototype political map of Europe. Note that various ways of labelling the provinces have been tried out.

Figure 4: Extract of the political map of Europe.

3.4. City maps

The current atlas contains already a number of maps depicting cities all over the world. For the new edition they should appear in similar size and scales in order to allow for better comparison. Production is done in a rather classical way: sources are mainly existing maps and georeferenced satellite images which are manually digitized in a GIS, and then imported to Illustrator for final symbolization and labelling. *Figure 5* shows a depiction of digitized land cover classes based on a satellite image, *Figure 6* an extract of the prototype city map of Montreal (without labelling).

3.5. Special thematic maps

Besides the standardized maps as described, the atlas contains a number of, mainly thematic, special maps. On one side, there are classical thematic maps covering one specific topic (e.g. in climate maps, which are taken over from

the current atlas), but also complex maps depicting several topics in combination, for instance economic indicators. Other maps depict a specific area and show e.g. the development of settlement over time. The maps are produced using various convenient technologies, however most of them are based on Adobe Illustrator. Especially for maps with statistical content, the production time can be significantly reduced due to available standard base maps with administrative boundaries and centroids.

3.6. Introductory part

It is also foreseen to add a new so-called introductory part at the beginning of the atlas. It should mainly support a better use and comprehension of the different maps and parts. The topics may comprise an introduction to maps and cartography, reference systems, projections, scale, generalization, map production, a general legend and an introduction to Swiss National Maps.

3.7. Indexes

Furthermore, it is planned to provide several types of indexes: A map index (table of content), a thematic index (list of main topics) and a detailed thematic index (keywords). The most important index, however, will be the geographical name index (gazetteer) which will be published as printed list at the end of the atlas. An internal database is based on the existing index from the current atlas, on a database set up by the Atlas of Switzerland (national atlas) and on the freely available Geonames database; it consists of more names than those which will finally appear in the atlas. The extent (and page number) of a single atlas map is used to extract the respective names from the database. They will be joined with additional information such as area and line objects, therefore centroid information is needed for matching. Koblet and Hurni (2013) provide a detailed description of the database setup. The database is currently NOT used to automatically place labels on the map. Labels are placed manually or are taken from the former atlas version and are only then be included in the database according to the workflow described above. Adjustment of labels parallel to latitude lines is done using functions offered by the MAPublisher software.

3.8. New Layout

The layout of the former atlas version was rather inconsistent. It was frequently altered due to changes of map structures and the re-assignment of legends. Furthermore the margins (white space) around the map frames was rather small. The layout for the new atlas consists of different templates for single maps (sizes, fonts, place for legend, etc.), and a page layout. *Figure 7* shows the page layout with different possible map sizes and their emplace-

ment. The maps are all delivered in Adobe Illustrator and the final page layout is done using Adobe InDesign. Furthermore the atlas is completed with a title page, a mast head, a list of sources used, and an endpaper. The book cover will be designed by a graphic designer, a competition is currently being prepared.

Figure 5. Digitizing of land cover from satellite image (Montreal area).

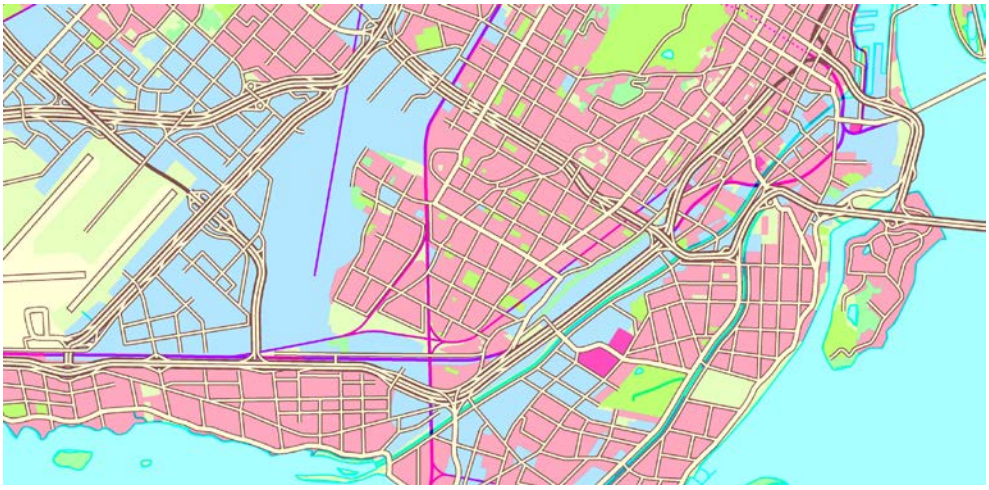

Figure 6. Extract of the Montreal city map prototype (different area depicted than in previous figure).

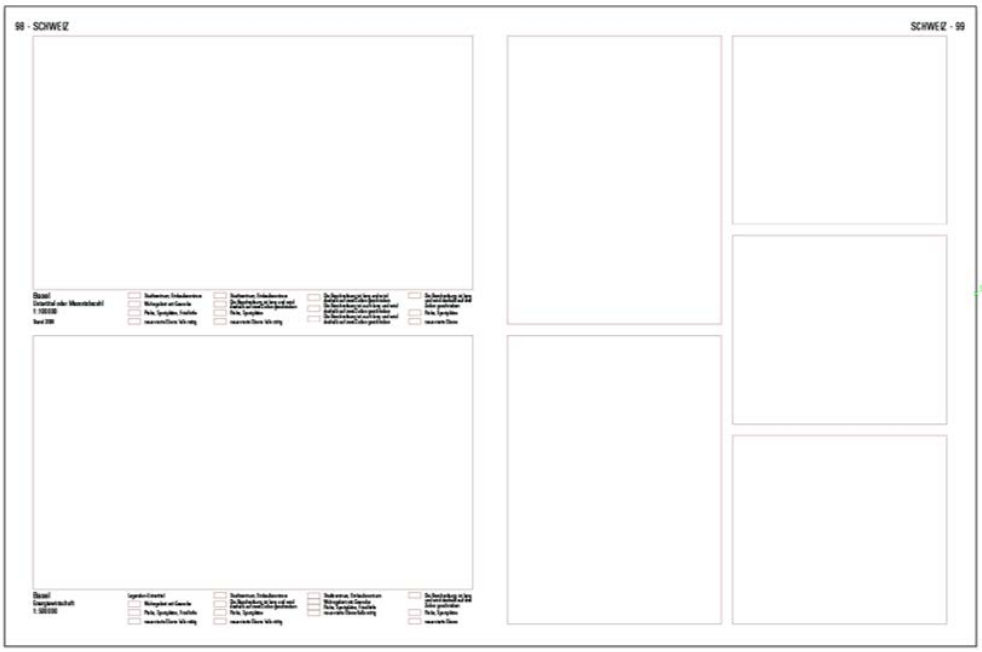

Figure 7: New page layout of the SWISS WORLD ATLAS.

4. Conclusions and Outlook

An important property of the production chain of the SWISS WORLD ATLAS is that it allows for the integration of any user-defined software which is suitable for specific (sub-) tasks. Starting with the authoring part of the workflow, the framework enables an entirely digital integration and harmonization of various sources (vector, raster, even analogous drafts). It is then decided whether those source data can be taken over directly or should be automatically adapted or manually edited. This work is done for each map by GIS and/or DTP software, switching between software is possible. As described, a unique, consistent gazetteer is set up centrally and linked to the individual maps. Each map is based on a common predefined layout. Furthermore, the process of producing each single map is tracked in a Concurrent Versioning System for planning purposes. Although the overall cartographic workflow is not modelled and managed in one specific, monolithic system, the different components, formats and processes are adapted in a way that they fit together. The first compilation of data may be time-consuming. However, the updating for the next atlas editions will be significantly simplified and accelerated. Furthermore, based on the same data, it is planned to entirely revise the interactive version of the atlas after the publication of the printed version.

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