CO-432

MAP AUTHORING IN THE AGE OF MULTIDIMENSIONAL GEODATA PROCESSING

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1. INTRODUCTION AND OBJECTIVES

In classical analogous and early digital Cartography, the map conception and the following map authoring (or map editing, map compilation) phase represented crucial parts of the map production process. The work-steps were quite rigidly defined. According to own observations in in-house atlas projects, even in current cartographic projects the map authoring process requires still about 50% of the resources.

However, today, map products are more and more based on already existing topographic and thematic data collections or even on volunteered data. In the ideal case, Web Mapping Services provide free datasets with a high geometrical and semantic quality related to a wide range of geographical topics. Furthermore new media allow a great change in map use due to new interaction and presentation techniques.

In the proposed paper – after an overview of the conventional map authoring process – the transferability of the classical map authoring to fully digital workflows and to new applications such as interactive maps and database-driven maps is examined. Existing digital authoring solutions and needs for new adapted tools are identified and finally illustrated by concrete examples taken out from the Swiss World Atlas, the official Swiss School Atlas (Hurni/Spiess, 2010).

2. CLASSICAL MAP AUTHORING

After Hake et al. (2002), the map authoring process consists of the search for appropriate data (sources), the consideration of quality aspects, the search for available editorial resources, the setting up of an editorial plan (definition of content), possible blueprint/sketch drawing and the setting up of working instructions. The classical overall map production process therefore starts with the map conception. Thereby the map is defined by formal and content-related aspects, including all related thoughts, approaches and version studies. This phase is followed by the detailed planning of the necessary work steps and by the actual execution and production phase. Tables 1, 2 and 3 (after Spiess, 1996 and Hurni, 2010) give an overview of the three phases: conception, planning and production.

Reasons for map project	Demand by market
	Legal order
	Complementary visualisation of special findings of investigation
	Special order
Involved experts	Client
	Data provider
	Map author
	Map editor
	Cartographer
	Distributor
	Map user
Analysis of map topic	Aim of the map
	Data properties (qualitative, ordinal, quantitative)
	Interpretation and classification
	Choice of data scales (discrete, staged, metric)
Graphic design of map elements with graphical variation	Area
	Line
	Point
	Text
	Diagram
Choice of design principles in Thematic Cartography	Generalisation (Selection, Simplification, Aggregation, Accentuation, Omission)
	Choice of colours (bright, pastel colours for areas, the smaller the darker, dark tints for point and line elements)
	Number of grades of class data: 5–7 steps. More important data = more shiny
	Clear contrast between background elements (lighter, pastel) and foreground elements (darker colours, stronger contours)
	Superpositions: Areas with textures, Text masking or other colour, Colour definition according to standard scales or associative
	Text placement if possible in empty areas or masking when similar colours

Table 1: Map conception (after Spiess, 1996 and Hurni, 2010)

Data capturing	Data (partially) available?
	New compilation necessary?
	Base map
	Copyrights
Suitability of source data	Geometric accuracy
	Semantic and geodetic reliability
	Up-to-dateness
	Homogeneity (various sources, regional differences)
	Re-usability, multi-functionality
Editorial planning	Title of map, aim
	Source material
	Format (type area, feather edge, max. print format)
	Scale (LOD, graphical density, degree of generalisation of source data, map test / sketch necessary?)
	Map projection
	Frame map, cropped map?
	Choice of design elements (weighting/balancing of components, legend, dimensioning)
	Place names
	Margin elements, back, cover
	Choice of printing technology

Table 2: Map production planning and editorial work (after Spiess, 1996 and Hurni, 2010)

Production instructions	General instructions
	Screening instructions (e.g. CYMK values)
	Print order
	Distribution instructions
Staff assignment	Division of work
	Definition of competences
	Sub-contracting
Equipment	Hardware
	Software
	Consumables
Costs	Pre-calculation
	Tender
	Controlling
	Final accounting
Time scheduling	Preplanning for bidding
	Scheduling of lots
	Coordination with externally processed tasks
	Schedule control
	Approval
	Buffer time for corrections
	Publication date

Table 3: Map production (after Spiess, 1996 and Hurni, 2010)

3. FROM DIGITAL CARTOGRAPHY TO DATABASE CARTOGRAPHY

Spiess (1972) states already in the early 1970ies that the division of work between map author, map editor and cartographer is not always clear. Especially between the map author, who in many case was identical with the customer and the map editor there was a smooth transition. In analogous time, the map editor did most of the editorial work and produced hand-drawn sketches of the relevant map layers which were then transferred to the cartographer for final drawing. With the change from analogous to digital cartographic production methods in the late 1980ies and early 1990ies, this obscure situation has been significantly accentuated. A wide variety of source material is digitally available, and the elaboration of hand-drawn sketches seems to be obsolete (Spiess, 2004). However the superposition of various source data layers in diverging scales and levels of detail on the screen of a cartographic production system and the limited lucidity (Hurni, 1995) create the impression of a less comfortable situation for the cartographer. However the possibility of working in a non-colour-separated way, having all input data as well as the drawing data always at hand, is a major advantage. This calls for a better instruction of the map editor in terms of cartographic design aspects (Spiess, 2004).

Since the early days of digital cartography, well-structured vector map data sets for the production of classical printed maps have been elaborated on a grand scale. Furthermore, a wealth of thematically, geometrically and topologically correct GIS-based data infrastructures (with maybe a lesser focus on cartographic high quality visualisation) are now available and can be re-used for all kind of cartographic projects. Due to (partial) automating possibilities, this allows for a more productive and flexible workflow. Especially for thematic mapping, base map elements can now easily be combined with content. Schulz (2009) and Schulz and Ulrich (2009) describe a Content Management System (CMS) for statistical data in Switzerland. The data can be entered in the system by data providers and allows for a consistency checking, but also for processing functions such as data aggregation. The data is then presented on standardised maps covering the area of Switzerland at different administrative unit levels.

This advantage of uniform reference areas and base maps cannot be called upon by international atlas projects such as the Swiss World Atlas, the official Swiss school atlas. In the following chapter, two examples describing a semi-automatic approach to author and edit thematic map content for this printed school atlas are therefore presented.

4. MAP AUTHORING AND DATA EDITING IN SCHOOL ATLAS CARTOGRAPHY: TWO EXAMPLES FROM THE SWISS WORLD ATLAS

4.1 Economy maps

The first example covers a workflow applied for the Swiss World Atlas, it aims at converting raw data from an internet source into clearly and easy readable cartographic diagrams.

The title of the map is “Foreign trade balance of selected countries”: For each major country on a synoptic regional economy map, a diagram depicting the import and export branches is placed at a suitable place (sea areas, if possible). For finding an appropriate, updated data set, an extended research on the Internet is carried out; a special focus is laid on the examination of the data quality. Finally, the decision for data from the International Trade Center (ITC, www.intracen.org) was taken, which proved to be a reliable data source. Then a suitable reference date for the diagrams needs to be chosen. In the case of the mentioned atlas version it is the year 2006, due to the availability of most recent data for all selected countries. Import and export data sets are available as Excel-files. The provider rounded the accuracy of the data to 1000 US Dollars. The data for the 66 selected countries are downloaded and brought together in one common Excel-file.

The numerical processing starts with the calculation of the detailed values of the 14 defined economy sectors, according to the so called „Trade Performance Index“ for each country. Because only the summary import and export values for each country are provided as accurate data, the detailed values of the 14 economy sectors need to be calculated by converting the provided integer percentage data. An unwanted side-effect of this simplification is the fact that equal values may occur for different sectors. But, in view of the accuracy of the generated diagrams, this little lack of precision is acceptable: The maximum angle error of a sector in a diagram can reach up to 0.9 degrees. For comparison: the smallest presentable angle/value in a diagram is >2 degrees. Then the choice of a suitable diagram type follows; in this case, the decision for wing diagrams was taken. Figure 1 shows such a wing diagram with schematic separation and denomination of the 14 economy sectors. Most colours in the diagram were predefined in correlation with other map content, for instance specific industrial products or mineral resources.

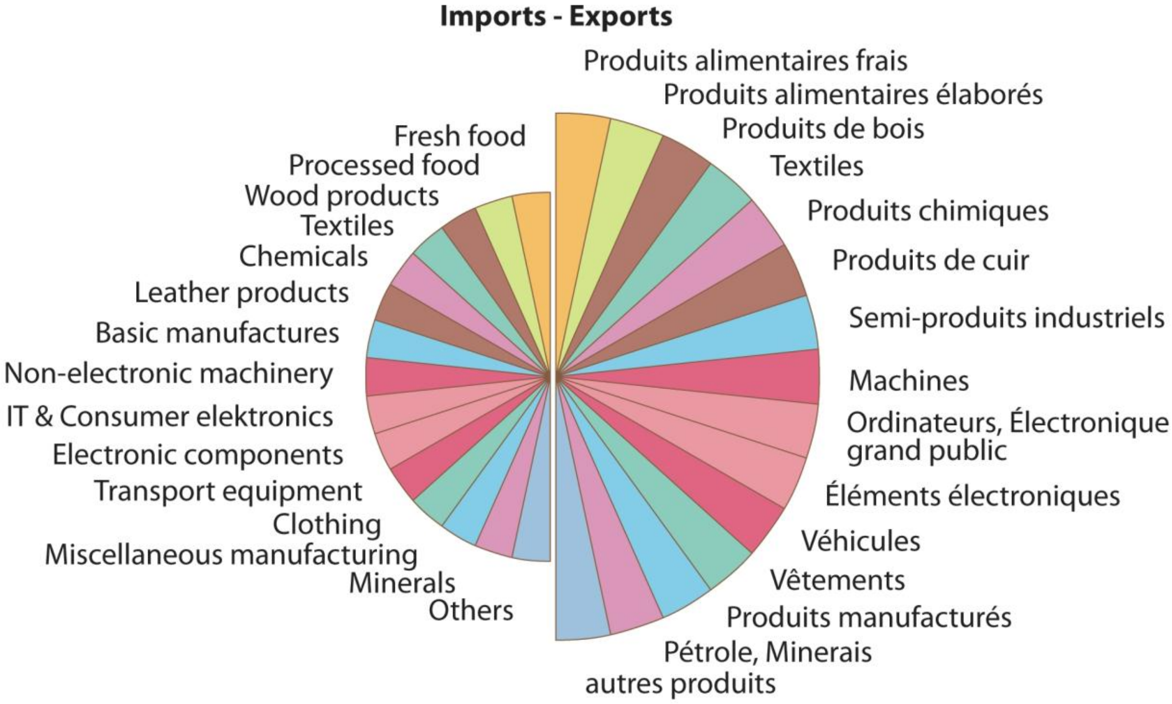

Figure 1: Selected diagram type with schematical separation and denomination of the 14 economy sectors. (source : International Trade Center, www.intracen.org)

The decision for a further data generalization was already taken on the basis of the Excel-file, i.e. before the conversion process. The reason therefore was a larger conception range for the aggregation of small and therefore less perceivable values. Such values below the defined minimum values were added later to the sector „Others“. As a result of the extremely different diagram sizes between the first and third world, different minimum values need to be defined (Figure 2). During this process four diagram classes were built, with presentable minimal values of 2, 3, 5 and 10 percent.

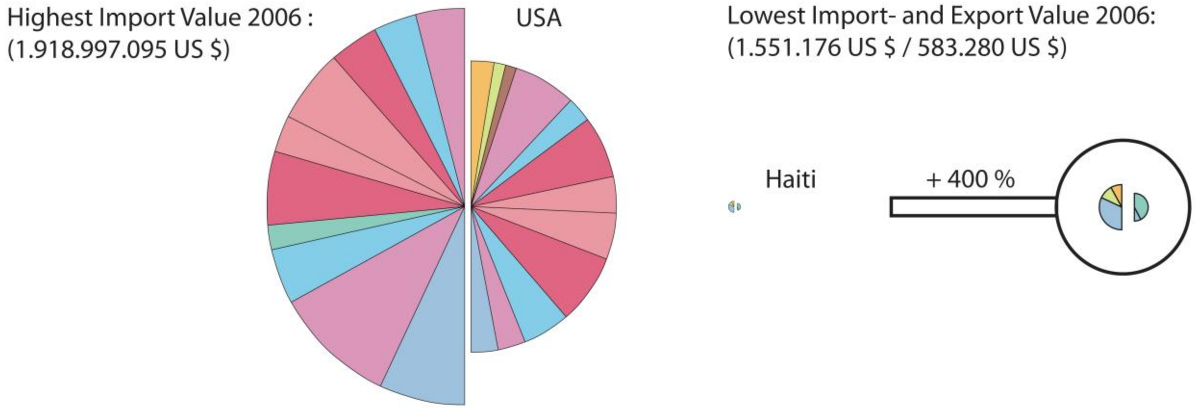

Figure 2: Extreme diagram size differences between a first world and a third world country in the Swiss World Atlas, edition 2010.

After the examination of the first results, an adaptation of the input values, as well as further conversions and comparisons might be necessary. With the approved input values, a final rendering of the diagrams is then carried out. In our case, all diagrams are generated and first cumulated in one Illustrator document. Only in a second step, they are copied and placed into the various maps, due to the high number of different map files. After this placement of the diagrams in the corresponding maps, the total values and denominations of the economy sectors for imports and exports in 2006 are added (Figure 3). Last but not least, all labels need to be translated from German into the other edition languages (French and Italian).

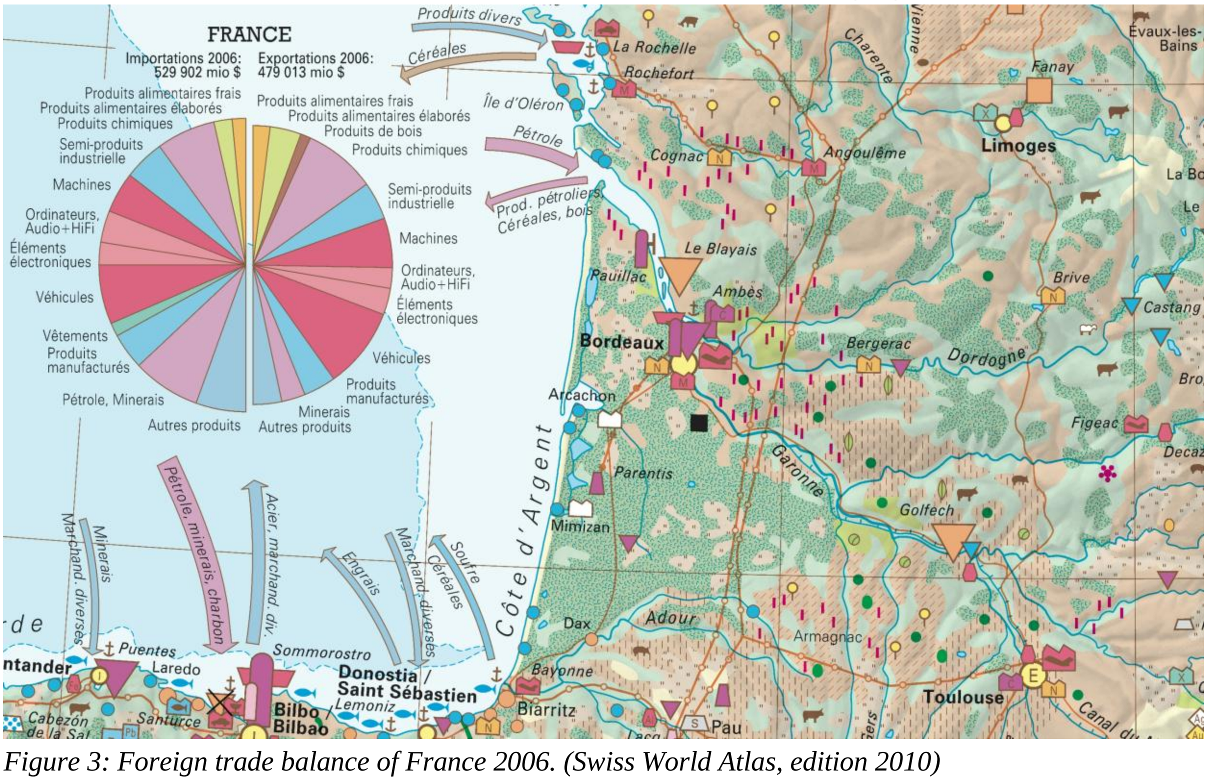

Figure 3: Foreign trade balance of France 2006. (Swiss World Atlas, edition 2010)

4.2 Labeling of Megacities and Metropoles

Also the second example is based on a workflow applied for the Swiss World Atlas. It deals with the urban population, comprising especially the classification of major cities and the labelling of megacities and metropoles. Again, the work starts with an Internet research for an appropriate, updated data set, followed by the examination of the data quality. The decision for a reliable data source is taken: in this case, the authors rely on various official data sources which are available in aggregated form in the free database of Stefan Helders (www.world-gazetteer.com). The most recent population data from October 2009 were available. The decision for a general reference unit is taken: The reference unit for all city population data in the Swiss World Atlas is the administrative area (political municipality). Otherwise – when including also the suburbs – an objective comparison of the visualized data would be impossible. As one result, for instance Paris (2.187.534 inhabitants) appears with a rather unexpected map symbol, in the same class as

Munich or Prague. The cities with more than 1 million inhabitants are split up into 3 classes: 1 up to 5 million inhabitants, 5 up to 10 million inhabitants (= metropoles), and more than 10 million inhabitants (= megacities). This classification was done already in the Excel-file. Compared to the former edition of the atlas, two new signature classes with newly designed are introduced: megacities und metropoles (Figure 4). They are adapted to the other signature of the legend and the existing signatures of the preceding atlas edition. The new symbols were created in the graphics software Adobe Illustrator and then placed in all corresponding maps (Figure 5).

Figure 4: Signatures for city population in the Swiss World Atlas, edition 2010.

Figure 5: Metropole Region of Brazil in the Swiss World Atlas, edition 2010.

5. CONCLUSION AN OUTLOOK

Especially the Internet now provides a wealth of only minimally or very heterogeneously structured data; More or less sophisticated data-mining methods try to bypass the lack of structure by for instance deriving knowledge from context information; this however leaves a rather high degree of uncertainty regarding the relevance of the queried data. This drawback of lack of structure can be mitigated by adequate and up-to-date metadata information, but this is still not a common standard, unless the map author relies on well-structured and edited data bases as in the examples shown. Well-defined geodata models including attributive information are clearly the best source for cartographers for deriving secondary cartographic data models out of general source data.

However, in the last few years, a paradigm shift away from GIS data with the classical split into geometric and semantic/thematic attributive data could be observed. This geographically-centred approach is more and more eclipsed by multidimensional data collections where beside the different data topics and together with timestamps the spatial location is just another attribute or dimensional triple/quadruple. From the GIS or cartographic view, the map space has been extended by temporal and topical dimensions. Some specialised software packages such as Geovisual Analytics programmes allow for flexible visualisation of such datasets. However one could now also argue that geographic reference information is just another criterion which could be included when querying this multidimensional space in such general purpose databases.

As for Web 2.0 applications, the situation is up to a certain extent similar, since the data collected in such environments is usually not compiled by experts. Since those systems are getting increasingly important, an important task of cartographic experts is to provide methods and software tools which support the authoring of maps based on such data. We are convinced that the domain knowledge of cartographers can be applied for such new challenges in a fruitful and future-oriented way.

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