**GAIA, the Comprehensive World Atlas**

Erkki-Sakari Harju, Timo Tarkka

Genimap Oy, Myyrmäentie 2, FIN-01600 Vantaa Finland

Genimap Corporation, a private Finnish cartographic and GIS company, made a decision in 2003 to produce a Finnish Comprehensive World Atlas with a Finnish approach. Until that point all “Finnish” world atlases had been translations and modifications from atlases produced by known international cartographic publishers. To accomplish this task a new copyrighted, up-to-date cartographic database was created which enabled Genimap Corporation to produce and sell high quality printed and digital global data in various formats.

**THE GOAL OF THE GAIA PROJECT**

One of the main objects in the GAIA project was to create a new copyrighted, up-to-date cartographic database to enable Genimap Corporation to produce and sell high quality printed and digital global data in various formats. Now, after the successful completion of the immense task, it has been proved that the collected data is well suitable for its planned use and a proper production environment for editing cartographic data and for producing high quality printed maps has been created.

Another goal was to produce a Finnish World Atlas with a Finnish approach and viewpoint. Before this all “Finnish” world atlases have been translations and modifications from atlases produced by known international cartographic publishers. With a Finnish viewpoint Finland and the neighbouring areas shall be presented more accurately and in a larger scale than the more far away areas. Also the topics presented in the Geography section should have, if possible, a Finnish approach.

**MAKING OF THE GAIA ATLAS**

The contents of the GAIA Atlas have been divided into the following sections: Geography, Geographic Maps, Index of Names, Index of Topics, the Gazetteer of Nations of the World and the UNESCO’s World Heritage Sites. Each section was nominated its own editors, who were responsible for the Editor-in-Chief.

The production of GAIA was arranged according to the following scheme:
The work started on April 28 2003. A strict scheduling was done for all sub projects as the GAIA, the Comprehensive World Atlas had to be ready and delivered to the customer on June 15 2004. The most important task for the project management was to define and obtain resources for the project. Altogether the production team included 50 persons. In addition, several stages and tasks were subcontracted, for example, the name processing and transportation network generalisation. Planning and process testing required around ten persons, editing and writing of scientific articles 23 persons. By profession, the people involved in the project were surveying engineers, cartographers, ADP specialists, workstation operators, image procession specialists, proofreaders and editors. Altogether, more than 20 man-years were used to complete the project.

After the editorial board had agreed on the contents of the Geography section, the best Finnish specialists were called on to write the articles. The planning, contents and design of the thematic maps, drawings and pictures were made together with the authors.

The first task in the planning of the Geographic Maps section was the sheet division system, after which the projection parameters were defined for each double page opening. The main projection used in the atlas is Lambert Conformal Conical Projection. Continental maps use Lambert Azimuthal Equal Area Projection. Thematic maps displaying the entire globe and in other small-scale maps have Robinson’s Projection. The maps covering Finland are in Gauss-Krüger Projection.

Public domain GIS databases were used as the source data for the GAIA, the Comprehensive World Atlas project. These databases are mainly based on the American Digital Chart of the World. The mostly used databases were the World Data Bank 2 (WDB 2) and V-Map 0. The comprehensive list of source data can be found at the end of the atlas. In general, these databases contain unclassified raw data, which the production team had to classify, generalize and update. The most demanding data processing task was the names, including the selection of names, finding Finnish equivalent – if available, and checking grammatical correctness.

All in all, the GAIA, the Comprehensive World Atlas project can be seen as a model example of seamless cooperation of experts of various professions.

**DESIGN OF THE ATLAS**

**Layout of the pages**

The general outlook of the Atlas was selected to be traditional. The finalisation of the atlas page appearance was made by using test pages. Test persons gave their opinions on shown samples and the best alternatives were selected according to their responses.

To make topic finding quick and easy, the production team decided to use colour strips on the top left corners of the atlas pages. The Geography section as well as each continent, index and glossary were given their own colours. In addition, in the Geographic Maps section each page has in its top right corner a small map, which shows the location of the map page within the continent.

Each double page opening in the Geographic Maps section has some standard information: the scale of hypsometric colours, the name of the double page opening, colour strip for easy topic finding, small location map, numerical scale, scale bar, reference to Index of Names and the markings to adjoining pages.

In the Geography section, each double page opening covers one topic of which most have both global and national approach. These two viewpoints have their own thematic maps displayed. The location of maps and pictures on these pages is defined according to the master layout to help the reader to find the information in the same location inside each double page opening. Thematic maps, pictures and drawings are all according to the same uniform colour scale to assure that different double page openings fit well together. The contents of each double page opening were well pre-designed before the final texts were written for these pages.

**Cartographic Design**

The cartographic design included finding proper line weights, colours, text fonts and symbols. The work needed numerous tests, sample pages and proof plots. The design of the maps was made so that same legend could be used for
all geographical map scales.

The hypsometric colour scale is traditional. It begins from light green, turns brown and ends in light purple. The density of colours was kept so low that black texts are well readable. Joining of hill shading and hypsometric colours proved to be problematic. The shading could not be overly dark in mountainous areas because it would hide the texts and on flat areas it should not spoil the hypsometric colours. According to careful testing, finally a shading was selected, which had a strong contrast. It left the flat areas clear and did not blur the hypsometric colours. The maximum shading density of black colour was 0.43. The available digital terrain model (DTM) was mostly built on 1 x 1 km net. It depicted the landforms very nicely – even the largest sand dunes on the Arabian Peninsula can be seen. The hypsometric layers and hill shading were prepared according to the same DTM. The same basic colour scale of hypsometric tints was selected for all geographical map scales. Only the hypsometric intervals varied between the different scales.

Fig. 1. Sample of hill shading and hypsometric colors. The contrast of shading was adjusted so that it did not affect the hypsometric colors.

When selecting the text fonts, the aim was to create a clear topic hierarchy. The size of selected font correlates with the importance and size of the topic. Different font types are used to classify the topics. The final font types and sizes, which were selected to the GAIA, the Comprehensive World Atlas, are a result of several test works and approval of test groups.

The legend of the GAIA, the Comprehensive World Atlas explains in detail the classification according to the font size and type. In the same connection there is a sample page, which explains the information in the map frame, connection of text fonts to the map, map symbols and reference to Index of Names. On the same page there is a written description about the background of hypsometric colour scales for land and sea as well as a short introduction to the map coordinate system.

PLANNING THE CONTENTS

Geography Section

In the Geography Section it is clearly seen that the GAIA, the Comprehensive World Atlas was made for Finnish readers. Nearly all articles starting from cosmology and covering geology, history and natural sciences have a Finnish approach or an example with a connection to Finland is given. The contents are arranged with the principle From Far to Near both chronologically and according to the geographical location. Each topic has its own double page opening.

The first topic, The Earth and Space, starts from the universe and proceeds through the galaxies and solar system to the Earth and the Moon. The second topic, the Nature System of the Earth deals with the structure of the earth, the
continental shields, the climate, the hydrological cycle and the processes of organic nature.

The third topic, History of Man, starts from the human evolution and the migration of Homo Sapiens all over the world, followed by the sub topics the Early Civilizations and the Great Voyages of Discovery.

![Fig. 2. Great Voyages of Discovery. Sample of thematic maps in the Geography Section.](image)

The fourth topic, The World Today is an overview to the systems, which are created by Man. The sub topics covered, among others, are Religions, Languages, Raw Materials, Economy and Traffic.

The next two topics concentrate on Finland. First comes the history of Man in Finland, which starts from the Glacial Era and continues to the year 1990. Also a double page opening dealing with the history of Mapping of Finland is included. The second topic deals with the present situation of Finland as part of the European Union and the future aspects. The History Time Bars show concretely on two double page openings what happened in Finland and when, together with facts what happened at the same time in other parts of the world.

In the last pages of the Geography section, the Gazetteer of Nations presents briefly all states of the world. The reader can find all the basic facts of independent states including the page number on which the state in question is shown.

**Geographic Maps Section**

The basic scale of GAIA, the Comprehensive World Atlas is 1:5 million. All inhabited areas of the world are shown in this scale or larger. Only the Polar Regions and sparsely populated areas of Siberia and North America are shown in smaller scale. The Finnish approach is seen in the fact that Finland and the Nordic Countries are treated as if they were their own continent and are shown in larger scale than 1:5 million.

The maps within a continent have been arranged as follows: first physical and political small-scale maps of the continent, scales between 1:14 million and 1:37 million. They are followed by maps, which cover the whole continent, scale 1:5 million. With Finland the scale is 1:800 000, Nordic Countries 1:2.3 million and Europe 1:3.5 million. When necessary, for example, with the Nile Valley and the European mini states, larger scale insert maps are used.

The aim has been to create a logical entity on each double page opening. As a result, there are several overlapping pages, but on the other hand all European states, except Russia, are shown as a whole.

At the end of the continental maps, there is a double page opening showing the best-known islands of the continent. The islands were selected according to their tourism importance (the Balearic Islands), historical value (Guam, Tarawa) or
other subjective factor. The scales of the island maps vary between 1:500 000 (Bear Island) and 1:3.5 million (the Spitzbergen).

Fig. 3. Island map of Tahiti.

The Indices

The Atlas has four indices: the UNESCO World Heritage Sites, the Nations of the World, Index of Topics and Index of Names. The UNESCO World Heritage Sites is on a double page opening index, which includes all 758 World Heritage Sites of UNESCO (situation 2004). The sites have their own symbol and number on Geographical Maps pages. The number refers to this index, which includes an explanation of the site.

The Nations of the World gives a short statistical introduction to each independent nation. The Index of Topics is on a single double page opening listing the terms and topics of the Geography section.

The Index of Names includes 70 000 names with a reference to the Geographical Maps section. The index has additional data in connection to the name: classification as water area/mountain/peninsula etc. Also if the same name exists in several locations, then the state or county has been added to the name, for example, Paris, France; Paris, TX, USA; Paris, TN, USA.

PRODUCTION PROCESSES

Geography Section

The production of the Geography section started with topic definition for the double page openings. The developing group determined which maps, diagrams and pictures were needed. After the contents had been defined, the preliminary layout was designed as well as the article lengths estimated. The maps and diagrams were made using mainly Free Hand and InDesign software. The authors prepared the texts, of which style and contents were checked. Then all information on a double page opening was combined and proof plot made for corrections. The Geography section contains 41 articles written by 22 authors.

Geographic Maps Section
The databases for geographical maps were made in MapInfo environment so that all databases were in lat/long form. The globe was divided into 16 pieces and the nominal scale of data was 1:5 million. As mentioned earlier, Finland, Nordic Countries and Europe were shown in larger scale. On the other hand Siberia, Northern Canada, Alaska and Antarctic were shown in smaller scale.

Cartographic data was collected and edited in MapInfo format. It was converted into the projection used on double page openings and into Intergraph .DGN format. When editorial corrections and additions to the data were made these all were added into MapInfo files. This guaranteed that the corrections were made into the base database and not only into the double page opening database. The tool used to prepare the double page openings was KarJu software, developed by Genimap. KarJu acts as a user interface, which allows MapInfo files to be transformed by FME translator into Intergraph .DGN files. For each double page opening, its own KarJuJob file was created which contained all vector and raster data necessary for preparing the double page opening. KarJu was also used when the double page opening files were processed into CMYK colour separation files as well as when the frame and map were joined together. The production process of double page openings was done in such a way that the contents were as complete as possible for the proofreading.

The maps of continents and islands were made in FreeHand environment. In the continental maps the new databases, which were created during the project, were used. The names, however, were made separately for each map. The maps of islands were made from other sources in larger scales.

Names

The preparatory works of the processing of names were as follows

1. Deciding the text fonts and sizes
2. Constructing the necessary special fonts and symbols
3. Preparing the Oracle database
4. Selecting the source data

The source data of names for geographical maps was mainly the Geonet Names Server (GNS) containing 5.3 million names, Geographic Names Information System (GNIS) and United States National Atlas (USNA).

The name selection as well as the addition and classification were done in MapInfo environment, followed by necessary translations, transliteration into Latin alphabets and adding of exonyms. Next the names were filed according to nations to an Oracle database. After these steps, the names had the following properties: classification, correct font and font size, tilting according to the coordinate net. Cartographers did the location setting on the screen. Proofreading was done in the final scale from a sheet with all other data on place as well.

Hypsometric Layers

Zones for Heights and Depths, Shadings. Globe and Gebco databases served as source data, which was used to create height and depth zones as well as hill shadings. Problematic areas were the Polar Regions, date line and the source data itself as it was extremely detailed. This elaborateness caused problems in data processing, because the databases were extremely large. The hill shadings were created for each double page opening individually. The contrast and maximum density were determined so that the shading did not disturb the hypsometric colours and the texts in high mountain areas were readable.

Height Zones. The grid of 1 x 1 km of the Globe terrain model was too detailed for height zones, thus the model was generalized using Intergraph MGE Terrain Analyst. Contour lines were made by Vertical Mapper and they were generalized once more. Filing was done in MapInfo format.
Fig. 4 and 5. Example of names database processing. On the top is a plot of original database contents and below the final map in 1:12 mill. Scale.

**Map Frame Information**

Map frame information was done individually for each map page opening. It was created by using InDesign software. First proofreading was done without the map and the final reading when all the map contents were included on the page.
Index of Names

As the cartographic positioning of names was recorded into .DGN files, the preparation of the Index of Names had to be based on the same .DGN files. In addition, the grid together with alphabets and numbers was needed for exact location. The first task was to create a priority table, which stated from which double page opening the names are mainly taken. For example, the south coast of Spain is seen on double page opening 254-255 “Morocco and Algeria”, but the names of Spain are collected to the Index from the double page opening 164-165 “Portugal and Spain”, on which all of Spain is visible. This method guarantees that all names, which exist on the Geographical Maps section, can be found in the Index as well.

Since the continent and island maps were made by using FreeHand, a different method for collecting names had to be used for the island maps (the names were not collected from the continent maps as they had already been collected from the larger scale maps). Names on island maps were collected onto Excel sheets, classified on the screen and then added to the Index of Names.

SUMMARY

The GAIA-project was an immense task which was completed in the given timetable. The publisher, Weilin + Göös Company was pleased to the result. The producer, Genimap Company created a global cartographic database of its own and developed new production methods. The production team is proud of its work.

THE ATLAS

GAIA, Suuri maailmankartasto (the Comprehensive World Atlas)
Publisher: Weilin + Göös, Helsinki, Finland
Producer: Genimap Oy
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Extent: 464 pages, four-colour pages 360, Geographic Maps 248 pages, Geography section 96 pages,
Index of Names: Over 70 000 place names
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Authors:

Mr. Erkki-Sakari Harju, Chief Cartographer, Genimap Oy, erkki-sakari.harju@affectogenimap.fi
Mr. Timo Tarkka, Cartographer, Cartographic Production Supervisor, Genimap Oy, timo.tarkka@affectogenimap.fi