# The study on the modes of the Digital Cartography and Map Publishing

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## Abstract

Considering the kernel of the process of digital cartography and map publishing, This paper analyses and summarizes the defeats and merits of the two modes of digital cartography and map publishing based on the GIS and based on the CAD at the present time, presenting an integrative mode of digital cartography and map publishing, including relational key technique problems.

## **1** Introduction

Computer technology applies to map cartography, which make the discipline has had the huge transformation, has enriched the map content, Also changed from the cartography to the publication tradition map production process entirely. Digital Earth and digital city emerge, widespread application of GIS cause the software platform of the digital cartography to be more fused into the GIS. The software package of GIS has been expanded in the function unceasingly, Its cartography and publication function also have been strengthened unceasingly. The method of map compilation is being changed from scanning paper to vector to aims at each kind of foundation space data model gradually. The map editing based on spatial data comes into mainstream. Looked from the digital map cartography and the publication process, The core question of the digital map cartography and the publication is the data gain, Data processing, Data output, But the ultimate objective of the cartography and the publication is to realize digitization and the integration of the cartography and the publication.

According the result of analyzing the domestic and foreign methods of the cartography and publication at present, two kinds of models may be summarized: one based on GIS and the other based on CAD.

# 2 The Cartography and Publication model based on GIS

The positional information and the attribute information of the spatial entity is inputted firstly and edited, the space geography database is established, then the attribute information is represented by symbol, the spatial data is displayed by the visible form (as figure 1).

In this model, the geography attribute encoding method is used for geography data, in particular to the attribute data, and stored and managed them by database form. Each spatial object geography attribute may be described from many aspects, For example the rivers attribute may be described from the rivers length, the depth, the current capacity, the rank and is open to navigation and so on.



Figure 1. The Cartography and Publication model based on GIS

Its characteristic as follows:

1) It is easy to derive the new map and update map

The attribute codes, the coordinates and the topologic relationship are used to describe the object stored in the software of GIS, which faces the geography entity, does not stipulate to use any symbolism to express concretely, Thus data saved is independent to the cartography expression method. The method which information stored and visible symbolic representation on medium is separated enhances the flexibility of the data retrieval and the graph expression. With the aid of to graph tool, the data may be extracted as necessary to produce a kind of the map which meets some needs.

To produce a new map, the method of the space data analysis and the processing is needed to renew firstly and new information is extracted and derived; To renew a map, the data in the spatial database is needed to be renewed firstly. The method which data stored and graph expressed is separated causes it easy to derive thematic map and renew map. 2) It is advantageous for fast, diversely determines the represent form of map

The geography information stored in GIS and the visualization symbol is separated, they can relate through look-up table, The look-up table is one kind of special data file, It at least contains two items: one is the same with an item in property sheet, its value is taken as key in look-up table; the other is the symbol parameter.

In this way, the different style and characteristic map can be produced by only changing the code of symbol parameter, Moreover being used look-up table, the data reserves may be reduced, which is similar to legend in the map, the similar attribute symbols in the entire cartography region are decided by the symbols of legend.

3) The central goal of GIS is not in map cartography and publication but in spatial geography data analysis and application

The cartography and the publication only is one kind of form in its output unit.

4) The color management, imposition, character, the chromatography, the relations of overprint and so on are not be considered in the publication for print.

The publication functions in print are hardly any be considered; only it is called the hard copy. ESRI already realized the question of the printing publication of complex map, and has developed ArcPress2.0 for ArcView, The map produced may be exported to the EPS form, But cannot satisfy the request for the printing publication completely.

5) The edition condition and the graph condition are not unified

The condition which edition and the graph is separated causes certain the question which discovered in the cartography condition must be returned to the edition condition to revises, moreover it is difficult to find the accurate position rapidly, thus the sole workflow appears many times, the working efficiency is reduced. It brings very many inconveniences for the cartography and the publication.

In the model, the central task of GIS is the spatial data management, the analysis and the application, the GIS is used to output map only is hinting, so cannot achieve the request of the specialized map publication. Many GIS system even only can carry on the screen demonstration and the print out, but cannot carry on the specialized EPS output.

### **3** The cartography and publication model based on CAD

The cartography and the publication model based on the CAD may be summarized like the figure 2.

In this model, the method of inputting the position of the geography information is not too different with the general GIS, But to the attribute data, what is inputted and stored is not attribute code of the spatial feature of geography, But is the parameter which be used to describe the attribute characteristic by means of graph or said is the graph attribute code. Moreover the graph parameter of attribute data and the geometry data are put on the same place, stored by document.





*Figure 2.* The cartography and publication model based on CAD Its characteristic as follows:

1) Cartography process is simple, the graph input is easy, establish the graph is quick

It uses the graph attribute like symbol the form, the size, the structure, the color and so on and the position coordinates to describe the spatial object, It faces the cartographic symbol or the cartographic, thus it is independent to the spatial geography meaning. It relates the storage of the geography information and visible symbol, which makes the data for cartography structure simple and the process of cartography intuitionistic, The understanding to the graph parameter must be much simpler than to the geography attribute and its the relational, therefore it is easier to operate.

2) The edition condition and the cartography condition are unified

The differences of nature of the geography entity are expressed by the graph parameter in CAD.

When edited, the graphs on the screen are already reflected according to the corresponding symbol shape, the color, the size and the angle and so on, the edition condition and the cartography condition is unified, which makes it be very easy to discover the mistake for the planner, the mistakes can be revised and relations between features can be harmonized real-time,, but does not like the cartography model based on GIS, the edition condition and the cartography condition must be switched.

3) The geography mathematics foundation lacks

The map is a two-dimensional space expression form established in the certain geography mathematics foundation, the projection transformation and the scale transformation in map compilation process can not be carried on in these software, still only depend upon the artificial method or other specialized tool software to complete.

4) Its key is to design general graph

Like Illustrator, CoreDraw and so on, they are not be developed for the map cartography specially, before used to map, the very many preparatory work, like establishment symbol storehouse, lamination hypothesis and so on, must be done

5) It cannot revise and carry on the essential spatial analysis according to query of the geography attribute

It is often essential to operate attribute database, renew data and extract information when renew map and make a new map, but there is not the inlaid or external database, thus data cannot be revised according to the geography attribute, to process the map contents only depends on the deleting the feature in document or the re-input graph attribute and so on. Its efficiency is extremely low when to renew the map and derive map based on the digital map produced in these kinds of system, the efficiency is low, cannot realize renewal of map under the digital environment quickly

6) Data is organized according to graphic mode

The data produced can't exchange with data in GIS effectively, because it does not have the geography attribute data in fact, thus causes it is difficult to unite with GIS. Although it can carry on the partial data conversion through some industry standard like DXF, but can bring the bigger data loss in the switching process.

In the model, there is the very strong superiority in the graph edition, image processing, mixed setting and EPS output and so on, but generally cannot accept the digital map which produced in the software developed for producing digital map specially, which causes cartography and publication can not be linked up. If these software are used to publish map, data acquisition, the edition and the output must be completed in one system, it is difficult to use the data created in this system by other cartography system. In a sense, this is also one kind of waste. This method is adopted mostly when paper map is produced only.

#### 4 The integration model of cartography and publication

Through above-mentioned two kind of cartography and publication model being analyzed, either cartography function is weaker, or the publication function is weaker, there are two plans can solves this problem: one is directly to increase the publication output function in the geographic information system foundation, Arc Map is on behalf of the product. It although has realized the cartography publication output, but its output result could not achieve the publication printing the quality requirement, does not have the technical process and the quality monitor routine required in the map publication. It belongs to the model based on GIS essentially. Only the data produced in GIS is transformed into the form which can be used in map publication through some kind of transformation way. The other is to make map symbolic database in the foundation of general publication system, and geometry graph is linked with attribute information. This plan is a model based on the CAD essentially, does not have the map symbolic database, the complex map symbol, especially the line and polygon must be scattered into the simple graph inevitably. This operation is irreversible, the graph scattered can not be restored to the primitive geography data.

The so-called integration only is on superficial, some degree integration, but the integrated problem would be solved truly, following several essential technologies must be considered:

1) Synthesis application of multiple source data

If each kind of current material (data) can be applied synthetically in the map cartography and the publication process reasonably effectively, map quality and production efficiency may be enhanced. Along with practical application of each kind of cartography technology and diversification of the way of data acquisition, the material which can be used in the process of the production of map cartography and publication is more and more, like paper map, digital map, aviation image, satellite remote sensing image, GPS survey data and so on. The data situation is extremely complex. Therefore the synthesis application of multisource data (material) becomes an important constituent of the digital map cartography and publication. The integrated model of the digital map cartography and publication should provide each kind of method of connection used and the conformity aiming at each kind of data form of the geography and the graph. To the different form, the different scale, the integration storage, the management and the dispatch of different type data, the code transforms and mathematics foundation transforms of each kind of vector geography data can be completed; the many kinds of remote sensing image and the GPS data and so on can be imported in visualization way.

2) The integration data model which satisfies the request of the digital cartography and the publication

The data used in digital map cartography and the data used in publication are different (as figure 3). The integrated model needs a comprehensive data model, Here said the comprehensive model is not the addition of the digital data model and the data model simply, but is the data model that can realize the communication of cartography and publication in a platform mutually through some level feature after similarities and differences of geography space information and the publication graph information are considered fully and the difference between them is conformed thus achieves synchronization carried on of the renewal of the geography information and the cartography and publication

The integration of map publication and spatial data production causes the geography information and the map information realize interaction and achieve mutually adaptations and mutually production of two kind of products.



Figure 3. The Way of processing data is different according to different models

3) The data model can be used in many kings of publication pattern

It is the most important achievement of cartography to realize the map publication, Because the process of map publication is decided by the cartography goal and the use, involves to the many kinds of outputs way, The paper map, the digital map, the issue electronic map and the special map must be provided simultaneously in a production process, but also convenience of the acquisition and utilization of each kind of spatial information and the function should considered, the space information service based on the network can be provided.

Especially to the publication pattern of prints, each kind of and the non-geographic features must be described effectively, and their printing attribute also can be described, for example, overprint, knockout, the printing sequence and the masking type and so on; geographic features can be organized according to the publication pattern and can exchange data with other cartography systems or the GIS system conveniently.

## 4) Function modulation

Each module alone is a function entity, the modules can interconnect by the visiting interface, this is helpful to the function expansion. The omni-directional exchange can be realized through the flow administration module.

5) Technical management and production management flow

The design, the data feeds division of labor, the inspection and edition, the output, the dispatch, the quality testing, opinion processing even financial control, personnel management and so on in the identical platform in the map produces, the synchronized transmission of the data flow, the information flow and the control flows can be realized, and the integration of the production management and the technical management can be achieved.



Figure 4. The Integration flow chart of cartography and publication

Must each personnel in identical work flow has the profound understanding for the cartography and the publication model under the integrated model be able introduces the integrated model to a more widespread application.

# **5** Conclusions

In the background that multi-disciplinary is intersected and fused, the knowledge renewal is accelerated and the user demand is diversification, the joint and communication of technology in the cartography and the publication must be strengthened effectively, Had the integrated platform, but also "the integration" knowledge must be grasped, The mapper should understand the technology standard and the flow of the publication fully, use the new publication technology and craft to enhance the expressive force of the map according to the map characteristic and the request, Avoiding the effect which some publications is unable to achieve specially the conventional printing publication as far as possible.

One carries on the map publication also has the certain specialized knowledge on cartography, can the sufficient planner's knowledge solve the problems such as the format conversion of cartography data, relations processing of cartographic feature and preprint processing aspect and so on. The integration of the map cartography and the publication can be achieved truly.

## Acknowledgments

The work was supported by Hi-tech Research and Development' Program of China(863 program)( No: 2006AA12Z223).

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## **Author Biography**

Xu Dehe received her master's degree in Cartography and Geographic information engineering from the Zheng Zhou Institute of surveying and mapping of information Engineering University in 2001. Since then she has worked in the research, technology and teaching of the publication of map. Currently she is working toward the PhD at the Zheng Zhou Institute of surveying and mapping of information Engineering University. Her research interests include cartography and map publication, image processing and copyright protection.