

A Geospatial Database for Vietnam, Lao and Cambodia

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Key words: geospatial database, Base map Database, Vietnam, Laos and Cambodia, etc.

SUMMARY

Recently, number of investment and development projects in the Southeast Asian region increases rapidly. This leads to increasing the demand on geographic data for studying, developing and monitoring the projects. At this moment, geographic data in the Southeast Asian region, especially in Vietnam, Laos and Cambodia have been assessed as lack of and scattered data. In the domain of the Vietnamese national research program named “GeoSpatial Infrastructure supports earth sciences of Vietnam, region and Global”, the objective of this research is to design a geospatial database that enables to provide sufficient geospatial data for socio-economic development projects as well as earth science researches in 3 countries, and to facilitate the cooperation and exchange geospatial data between departments of Vietnam, Laos and Cambodia.

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1. INTRODUCTION

At the convenient positions in the Southeast Asian region, Vietnam, Laos and Cambodia are interested and attracting a lot of investment from local and overseas organizations. A good understanding of natural conditions and socio-economic developments related to geographic space in Vietnam and the neighborhoods would help the investors to make right decisions. The rapid growth of researches and project's pre-feasible studies brought about increasing pressures on geographic data on this region. That is the reason why researches of geospatial infrastructure in 3 countries become pressing.

In 2001, a national research program named "GeoSpatial Infrastructure supports earth sciences of Vietnam, Asian region and Globe" has been launched under supporting of the Vietnamese government. The objective of this program is to investigate and propose solutions and technologies for developing a geospatial infrastructure of the Asian region and Globe that provides sufficient data and information for Vietnamese user's requirements as well as cooperation projects and earth sciences in Asian region and Globe.

In the domain of this program, the objective of this research is to design a geospatial database that is enable to provide sufficient geospatial data for socio-economic development projects as well as earth science researches in 3 countries, and to facilitate the cooperation and exchange geospatial data between departments of Vietnam, Laos and Cambodia.

2. RESEARCH PROBLEMS

At this moment, geographic data in the Southeast Asian region, especially in Vietnam, Laos and Cambodia have been assessed as:

- Lack of geospatial data: It lack of data in term of the area data covered and also in term of number of theme of data has been collected. For example, just a few parts of topographic maps of Vietnam and Laos are digitized and using as base maps for geographic applications. And, the thematic data only are collected for the specific projects at variety scale and scattering.
- Scattered Data: geospatial data is scattered not only in term collecting and gathering data but also in term of managing and distributing data. A specific theme of geographic data will be collected and managed by an authorized department of each nation. Therefore, different theme of data will be managed by different departments of different nations.

Thus the questions arise for designing the geospatial database that enables to provide sufficient geospatial data for any development and cooperation project in 3 countries are:

- Which data should be in the geospatial database for Vietnam, Laos and Cambodia?
- How to organize these data in a logical and consistent schema?

3. CONTENT OF THE GEOSPATIAL DATABASE

In order to provide sufficient geospatial data for any development and cooperation project in Vietnam, Laos, and Cambodia, the geospatial database should include:

- *A Base map Database*: provides data of common used features on terrain such as river, lake (hydrology), road, bridges (transportation), elevation points (terrain), administrative boundaries, etc. Data of these features are well geo-referenced and can be used as a base map for other thematic data.
- *Thematic Databases*: provide thematic data for professional works related to geographic space e.g. Meteorological impacts; Land use planning; Mineral resource studies; social-economic researches, etc. The scale of detail of each thematic database depends on the specific projects. These thematic databases cover all fields of earth sciences as well as social-economic studies. For example, Administrative database, Geological database, Climatic database, Hydrological database...

4. APPROACH OF DEVELOPMENT THE GEOSPATIAL DATABASE

The geospatial database for Vietnam, Laos and Cambodia is a very large and complicated spatial database. It is large in term of the number of themes it contained and the area that data covered. It is complicated caused of data is maintained and managed in different organizations as well as in different countries. Thus, data is existed in different scales, in different standards, and in different formats.

For those reasons, the question is the geospatial database for Vietnam, Laos and Cambodia should be designed in which way:

- To harmonize data from different source databases?
- To make data consistent?
- To keep the copyright on data of the specialized organizations To facilitate data exchange between different databases?

Many researches have been done to solve the same problems. Among them, two useful models are referenced in this research included *Geospatial Data Clearing House* (Bishr, 1998) and *Geospatial Data Service Centre* (Groot, 2000).

Considering the independency and the copyright of the specialized organizations, counting the cooperation of departments, organizations in three countries, and based on the experiences of applying the above two models, this research proposes a Geospatial database model for Vietnam, Laos, and Cambodia as following:

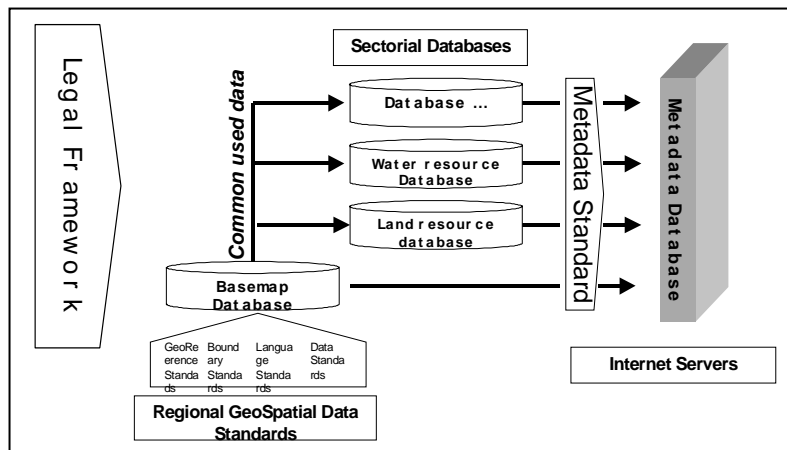


Figure 1: The proposal Geospatial Database Model

In general, the geospatial database includes:

- A Basemap database: provides basemap data that covered whole area of Vietnam, Laos and Cambodia at some common used scales. Basemap data in this database is structured in a set of standards (e.g. geo-reference system, schema, data format...) so that the other thematic databases can base on to generate or exchange data.
- A set of Sectorial databases: each Sectorial database provides a special data theme, for example, *Land Resource Database* provides all data related to land such as land use data, cadastral data, land use planning, ... The scale and the detail of these databases depends on the development strategies of the specific authority organizations or of the specific projects. However, data structure of these databases must be designed based on the structure and standards given by the Basemap database.
- Internet servers will be located at the convenient positions in the three countries, stored, managed and distributed metadata (data about data) of the component databases. Metadata in these Internet servers are frequently updated from the Basemap database and the Sectorial databases.

In this model, data users will search, discover and get the instruction to obtain data through metadata on Internet. The administrators of the component databases will make decisions and policies on data security and data distribution.

In summary, the Geospatial database for Vietnam, Laos, and Cambodia is a system of geospatial databases in three countries. In this system, the Basemap database plays a nuclear role, provides common used data and a set of standards for the other Sectorial databases in the system. In this system, databases connected together through Basemap database and Metadata databases. They work independently but in cooperation. Of course, it should have a legal framework that support the system operated formally.

5. A PROTOTYPE OF THE BASEMAP DATABASE

While the Basemap database is considered as the nuclear in the Geospatial database model, it is elaborated to the logical data model designing stage. A prototype has been made to test the data model and to address all the foreseen problems those may occur at the physical implementation.

- *Content of the Basemap Database:* According to Steve Grise (2000)'s definition, a basemap is a common set of map layers organized into a logical presentation for a specific map scale. Therefore, data in the Basemap database can be categorized as the following: Administrative boundaries, Population, Transportation, Land cover, Hydrology, Terrain, Ortho Images, Control points.
- *Scale of the Basemap Database:* 1:250 000 scale is chosen for the pilot designing because of the suitability of this scale to the development project at the national level, and the current data sources for data input. Currently, 1:250 000 topographic maps have been covered whole Vietnam, Laos, and Cambodia. In Vietnam, it is updated in 2000 and in digital form already.
- *Georeference System:* the Basemap database will be built based on the Global Georeference System WGS84. The WGS84 is chosen when considering to the capabilities of matching spatial data from different coordinate systems of three countries, and data from region and global map systems.
- *Database Design:* concepts and approaches applied for designing the conceptual data model including Object-base, Field-base approaches of Molenaar (1998), and the Georelational data model (ESRI, 1995). In summary, the Basemap database included spatial data layers and attribute tables. The attribute table describes thematic information for all objects in a specific thematic category. Spatial data in a specific thematic category is structured as spatial data layers according to spatial object types (e.g. area population layer, and point population layer). Spatial data layers is linked with attribute table through the object identified code. Figure 2 illustrates this relationship.

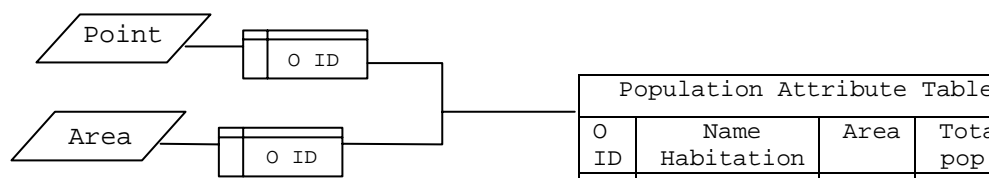


Figure 2: Spatial data layers and attribute table of a thematic category

- *Data Input and Consistency Processing:* data input for the prototype is collected in different scales and in different types, including: 1:250 000 digital topographic maps covered whole Vietnam; 1:100 000 paper topographic maps covered a part of Laos; 1:500 000 digital topographic maps covered a part of Cambodia; List of administrative units of Vietnam. When data input is in different formats and different map scales, all problems of data harmonize and consistency processing are concerned and solved with appropriated solutions. These solutions and approaches will be used for the

implementation at the physical stage of the Basemap database. Figure 3 is the comparison of topographic map and data in the Basemap database of some thematic categories.

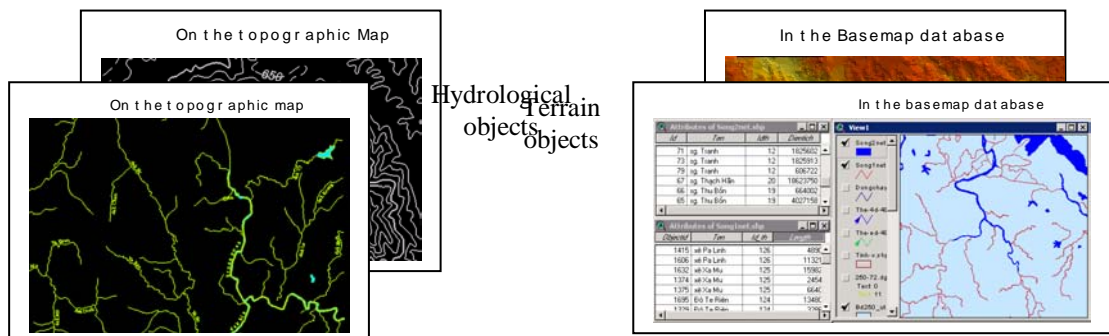


Figure 3. The comparison

On topographic maps, terrain surface is displayed as contours, labels elevation points. In the Basemap Database, terrain surface is a Grid model that has elevation value at any position on the surface.

Hydrological objects on the topographic are displayed as lines or fill color areas with the label names beside. In the Basemap, these objects are structured in two different layers and associated with two attribute tables that stored all attribute information of each feature. Then, these tables are linked with a Hydrology attribute table that stored thematic information of all hydrological objects in the Hydrology Category.

6. APPLICATION TO ELECTRONIC NATIONAL ATLAS OF VIETNAM

The Geospatial database model and the concepts and approaches for designing Basemap database in this research have been applied in implementation of Electronic National Atlas of Vietnam project.

The Vietnam National Atlas database also included more than 20 themes of natural and socio-economic conditions of Vietnam. Each theme has about 10 to 20 thematic maps. To manage these data consistently, and to facilitate sharing and exchange data, the Geospatial data model has been applied and introduced to Atlas project teams. A Basemap database is designed and developed, and provides basemap data for other 20 thematic databases of 20 themes of Atlas. All thematic maps of the Vietnam national Atlas are created based on the same basemap, and some of them can use the basemap data to generate their thematic data, for example, Slope map is generated from DEM of basemap data.

The implementation of Electronic National Atlas project has proved that the Geospatial database model is very suitable and efficient to manage a large and complex database. The structure of the Basemap database is suitable for GIS applications and enables to add thematic data.



Figure 4. Samples of Electronic National Atlas of Vietnam

Administrative Database: All data used for designing administrative map of Vietnam and provincial administrative maps are generated from Basemap data.

Relief Database: All most data in Relief database are generated from the DEM grid e.g. Elevation data, Orographic data, Slope data, and Deep dissection of relief data.

7. CONCLUSIONS AND RECOMMENDATIONS

It is necessary to develop a geospatial database that provides sufficient geospatial data for the user's requirements. However, this research is just the first step of investigation to the concepts and approaches for an aspect of geospatial database in the development a national and regional geospatial infrastructure. In order to make the Geospatial database model for Vietnam, Laos and Cambodia becomes reality it recommends that:

- Should develop a feasible project for the GIS Database for 3 countries (in officially cooperation)
- Should develop a legal framework for data collecting, managing, sharing, and distributing
- Should develop a set of standards at the regional level

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