# **Technical Letter**

# Metadata for Digital Topographic Maps of Vietnam

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### Abstract

The topographic map is considered as a very essential document, and used as the base map for any geographical application. Presently, in Vietnam the information about data (metadata) of digital maps not yet designed and built up in an adequate and sufficient way. Consequently, endusers are facing with many difficulties when using digital topographic maps. Further, this results in the difficulties in keeping of digital topographic maps up-to-date and in distributing topographic information efficiently. To solve the above problems, our research proposes a metadata standard for Topographic Maps of Vietnam, as well as providing a metadata management tool to facilitate the process of gathering, managing, distributing metadata related to Vietnam topographic maps.

# 1. Introduction

The distribution of digital topographic maps cannot be efficient without the support of metadata. The metadata plays a very important role in terms of marketing and instruction. It provides users information of the map such as whether it is existed or not, how good it is, what is the map scale, who is the producer, who is the approver, and how to get the maps, etc. In Vietnam, metadata, the information about data of digital maps is not yet designed and built up in an adequate and sufficient way. Consequently, end-users are facing with many difficulties when using digital products without a metadata. Moreover, the digital topographic map is produced and distributed in-efficiently. That is the reason why the research of metadata on the digital topographic maps becomes so urgent in the domain of geographical databases.

The objectives of this research are to propose a set of metadata for describing digital topographic maps, and to develop a tool for managing this metadata database.

# 2. Review of Concepts and Approaches

## 2.1 Concepts of Metadata

In general, metadata are defined as the background information that describes the content, quality, condition, and other characteristics of data (FGDC, 2000). For different perspectives, metadata can solve different useroriented problems.

## 2.1.1 For end-users

Metadata help a user to locate and understand data. It facilitates the process of querying, selecting and retrieving data. In case of digital topographic maps, a metadata database can

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answer an end-user with the following questions:

> Questions about the existence of data. For example, within the working area, are the digital topographic maps existed or not? Where is it available? Name and the contact information of the manager and distributor of these maps...

> Questions about the suitability of data. The suitability of a topographic map to a specific purpose can be measured by the map scale, accuracy and precision, time of updating data, data sources, data format, map projection, and data completeness. In addition, information of price and procedures for retrieving data also helps users to assess and determine which maps are most suitable to their works.

### 2.1.2 For data managers

Metadata play a very important role in administrating the topographic map's databases.

> In the process of making digital topographic maps, metadata encode all the information of who is doing, what and when it is finished, as well as the status of produce at each phase. These information help the manager in monitoring the rate of progress, and making appropriate solutions to keep the plan. In addition, when the time passes or the personnel changes, information of the content, the status, the environment and the technological process of making topographic map database will help the successor easier to take over the management tasks.

> For investment in developing databases, metadata help the organization to avoid redundant investment in data. The descriptions of the content, the status and other characteristics of each topographic map in the database may help the decision makers have ideas or solutions of using data for the appropriated projects instead of creating a new one.

#### 2.1.3 For data providers

Metadata can serve as a tool for marketing, advertising, distributing, and sharing data. Currently, the metadata approach is trending towards making information available to the public on Internet. It facilitates the publication of all information that data providers have in their databases, and the restrictions on accessing or using these datasets.

The data provider uses the metadata information system not only for serving the end-users but also for exchanging metadata with other data providers. In fact, the metadata information system has been used as a tool for the connection between geographical databases, data providers, data managers in the model of data bank, data clearing-house, data warehouse, etc. In order to facilitate data sharing, metadata provide information to aid data transfer such as data format, data process, data media, environment and technologies of building data.

#### 2.2 Approaches to Handle Metadata

There are two basic approaches to handle metadata (Smith and Trivedi, 1991):

*Self describing databases:* Metadata is a part of the database. It is derived from the entity itself, and becomes a part of the entity. It is automatically moved, copied, and deleted along with the entity. Metadata in ArcCatalog (ESRI) is an example of this approach.

Separate metadata layer: Metadata is managed in a deductive metadatabase above the database and answers queries about the organization, structure and functionality of the underlying database.

In additional, the GIS approach for managing and accessing the digital spatial libraries is introduced by ESRI in 1994 (ESRI, 1994). This approach used advanced GIS tools, GIS capabilities and coordinate information for a general purpose indexing system to library collections. This approach affects directly to people who produce and archive spatial data. But it is cost by using GIS methodology.

# 2.3 Information of Digital Topographic Maps of Vietnam

Currently, the information of a topographic map sheet and of the cartographic process is recorded in a document. The document is named "The Curriculum Vitae of Vietnam Topographic Map" and managed by the producer. The content of the document included (ATC, 2003):

### General Information

Name and Map sheet Number Map scale and geo-reference system Name of the producing organization Name of people are in charge in the process

Producing Duration

Name of the approving organization Approving Duration

Technical Problems have been solved Source maps Referential documents

Approaches

Specific problems have been solved during the process of making map Verification: Name of verifiers and levels of verification

### 2.4 Current Metadata Standards

Many researches have been done to metadata and some metadata standards have been widely applied in Spatial Data Infrastructure. Some of them can be very useful and used as reference standards for developing metadata standards of digital topographic maps. They are, for example,

> The geographic spatial metadata standard of American Federal Geographic Data Committee (FGDC, 2000). In June 1998, the FGDC endorsed the 2nd version of the FGDC Content Standard for Digital Geospatial Metadata (FGDC-STD-001-1998). This standard included seven main subsets, such as identification, digital quality, spatial data organization, reference system, entity and attribute information, distribution, metadata reference.

> The metadata standard draft of ISO/ TC211 (ISO/FDIS 19115:2003). This

standard is developed on basis of the standard of FGDC and the rudder of ISO. The ISO 19115:2003 defines mandatory and conditional metadata sections, metadata entities, and metadata elements; the minimum set of metadata required to serve the full range of metadata applications; optional metadata elements, a method for extending metadata to fit specialized needs.

The core element metadata standard of ANZLIC (ANZLIC,2001). This standard consists of 41 elements and grouped into ten different categories such as dataset, custodian, description, data currency, dataset status, access, data quality, contact information, metadata date and additional metadata.

# 3. The Proposal of Metadata Standard for Topographic Maps

The objective of this proposal is to design a structure for describing digital topographic maps as well as the process of making topographic maps. It is intended to:

> Investigate all information that may be required by users, managers, and providers in order to understand, retrieve, search, publish, and manage the digital topographic maps as well as the cartographic process.

> Structure the above information in a logical and consistent metadata schema in order to avoid duplicating the existing data or gathering impossible data.

The proposal of metadata standard is specific for Vietnam topographic maps that, in general, already are the standardized products and have specific using purposes. Therefore, it doesn't attempt to adopt FGDC or ISO standards, which made for general geospatial data. But it tries to make consistent with the content of those international standards as well as the standards for Vietnam topographic maps and The Curriculum Vitae of Vietnam Topographic Map. The main items of content of the above metadata standards

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are taken in to account and specified them into the context of topographic map.

In the first draft proposal, the content of metadata is grouped into 6 categories, including:

*Map sheet:* provides general information of a digital topographic map for the purpose of searching data such as Name, Sheet number, Contour's interval, map Scale, Names of administrative units are covered, Geographic position, Geo-reference system, Time of updating data, Time of publishing, Name of the producing organization, Name of the approving organization, Name of the publishing organization.

*Map Content:* provides detail information for discovering data such as Data format, Theme of map layers, Attribute, Data status (verified and approved, need to be continued, etc.), Data storage.

*Data source and Material:* describes data sources and material have been used during the process of making maps such as Name of material, Form of material (digital or hard copy), Type of material (map, image, document, etc.), Date of material, Name of provider, Purpose of using, Capability of using. In case of maps and images, more detail information are provided such as scale, resolution, data format, ...

*Lineage:* describes the history of a digital topographic map. Lineage data provides detail information of any stage of the process of making map such as the Data sources, Procedures, Approaches, Data quality statements, People in charge, and Criteria applied, etc. Metadata of this group can be used for the managers to monitor the rate of progress and for the users to determine the fitness of data for their purposes.

*Storage:* provides information for maintenance and retrieval such as File name, Path name, Data format, File's size, Media, Name of archives organization.

*Distribution:* gives an instruction to obtain data such as Name of distributors, Required official documents, Contact's information, Price of data, Media or approach to obtain data (online, by post...), Restrictions on accessing or using data.

This proposal has been sent to the data users and data producers such as Cartographic Publishing House, Arial photogrametry Topography Company to get comments and recommendations. This draft also is used to develop the tool for metadata management.

# 4. A Tool for Management of Metadata

Nowadays, a large number of digital topographic maps of Vietnam have been created at various scales. The approach to handle metadata associated with the data entities seems not feasible currently when these datasets now are stored in different types of media. In order to document the information of all digital maps have been produced as well as how maps are produced, it would be a suitable solution to design a separate metadata database.

A Metadata Database Management Tool is designed to facilitate the process of collecting, managing, and distributing metadata for the topographic maps as well as the cartographic process. The functionalities required for this tool are illustrated in Figure 1.

Search and Browse Data Functions: users can search and query maps based on metadata items such as map sheet number, map scale, administrative units, geo-reference system, and time of updating data... User can use both SQL and spatial queries, for example, selecting maps with a map scale 1:50000, or finding maps contained within one particular district boundary? In addition, users can also browse, analyst, and present metadata in both attribute data and map (see Figure 2)

Input Data Functions: to facilitate inputting data into metadata database, system provides (Figure 3):

A function to automate the generation of some metadata items from the data file such as map sheet number, map scale, map name, working area, contour's interval, names of administrative units are covered, geographic position, data format, and map layers.



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Figure1: Functionalities required for Topographic Metadata Database Management Tool



Figure 2: Query Interface

The rest of metadata items that describes the specific information of each map such as data sources, name of producing organization, or name of people in charge, etc. is encoded manually.

It is also possible to import data from other source for example shape file (ESRI format) or attribute table in DBF format.

*Output Data functions:* to provide options for user to export metadata to a report and an html file that can be used for web browse. The metadata report satisfies the requirement of making the curriculum vitae of a map in the Regulations of making topographic map (GDLA, 2000). The Html files are used for distant users searching and browsing the metadata database through Internet.

*The Metadata Database* is built based on the geo-relational data model and itself is a geodatabase. It included spatial data that represent the spatial extent of map sheets or the spatial queried objects (e.g. buffer zone, administrative units,..) integrated with other attribute metadata (e.g. map sheet's name, map scale, ...). The metadata database is physically separated from, but linked to the topographic maps datasets itself.

According to the regulation for topographic mapping, digital topographic maps must be stored in MicroStation format (.DGN). Presently, most of Mapping Agencies in Vietnam are using MicroStation in topographic mapping. Therefore, the present system is divided into 2 parts. The first one is based on Visual Basic Language and MicroStation Development Language to develop the interface and automatically generated input metadata function from datasets in MicroStation format. ODBC is used to link to Metadata Microsoft Accree database which is used to encode other information manually. Because it requires spatial queried capabilities on integrated data (spatial and attribute data), thus the second part of the system is based on ArcObject Language and it possible to use ARC/IMS (ESRI) to publish metadata on Web.

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File View Traicifu Metadata Nhập thông tin Wind	dow Help
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Mā mành BĐ: 1023 Phiên hiệu: F-48	8-93-A-b Khu do:
Tên mảnh BĐ: F-48-93-A-b	Nām xuất bản: 2004
Tỷ lệ BĐ: 5000 CS toán học:	K.cao đều đường BĐ: 12
Phương pháp TL:	T.gian bāt đấu: 0 1/08/2004
Công nghệ TL:	T.gian kết thúc: 01/10/2004
CQ nghiệm thu:	🖪 Tài liêu bản đổ liên guan
CQ phát hành:	ID: Phiên hiêu: F-48-93-A-b
CQ thành lập:	Phiên hiêu BĐ tài liêu
Ghichú: Test	Tỷ lê: Cơ sở toán học:
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Figure 3: Input data Interface

Currently, topographic map datasets are stored both at Mapping Agencies where establishing maps and Center Data Archive of Mapping and Surveying Department. Therefore, the system is designed to be a stand-alone system. So it is possible for Mapping Agencies to use to acquire and maintain the metadata as well as the Center Data Archive to use to distribute metadata. Metadata files should be submitted together with the map sheet datasets that they are belong to.

# 5. Conclusion

The development of the metadata database and the topographic map database is a very essential task for the Mapping and Surveying Agencies. By developing a tool for metadata management, the process of collecting, manipulating, and distributing metadata is facilitated. However, this is just the first step of developing a metadata standard applied for topographic map databases. The content of metadata and the tool for managing metadata need to be tested, verified and get comments and recommendations from users to optimize themselves before implementing. It is also recommended that, the metadata standard for Vietnam topographic maps should be included in the standard system for topographic maps.

Currently this system is a separate metadata system and a central database system. When the metadata standard is approved to be included in the standard system for Vietnam Topographic maps, this system should be developed to be a data Clearinghouse that would be involved all Mapping and Surveying Agencies in Vietnam. Publishing metadata in a Clearinghouse provides a searchable database of information about topographic maps and thus facilitates data sharing.

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