Design and Establishment of Multi-scale Spatial Information System Based on Regional Planning and Decision Making

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Abstract-Fast development of Geomatics and network integrated technology demonstrates that spatial information are widely used in regional planning and decision making. Existing non-standardized multi-sources and multi-scales data have a shortage of spatial information sharing in both internal and external application departments or units, especially in the network era. A pilot regional planning and decision making spatial information system based on a standardized and network sharing technology is presented in this paper.

The research area is composed of eight counties in Jinghong Region and Simao Region of Yunnan Province in China. Spatial information resources such as remote sensing, digital maps, and paper maps are collected from different departments. Statistics data such as agriculture, forest, earthquake hazard, ore, hydrogeology, ecology, transportation, population, tourism, and trade, etc. are the composition of the application system. The system will be mainly used by regional planners and managers in the province and the regions via Internet. The applications of general users are also considered.

Geographic Metedata standardization for spatial information is used as an Internet engine between users and datasets. Arc/INFO and ArcView GIS are the basic software for information integration. WebGIS is used for spatial information sharing design and GeoMedia is accepted as a basic web software platform. Other software for multi-dimensional information display and management are designed and applied for virtual reality planning and application in the project.

Index Terms-Metadata, information sharing, system design, spatial information system, decision making

I. INTRODUCTION

Geomatics and network integrated technology is widely used for regional planning and decision making. Governments are mainly users among the applications [1]. It is clear that traditional data sources such as paper maps and statistics data occupied by them are key data sources for digital system construction, which will be integrated with temporal remote sensing and other database information. Although public GIS software have the advantage to manage spatial information, standardized system design technology is still a shortage in spatial information system establishment.

In this paper, the authors present a multi-scale spatial information system design technology which is used for environmental planning and decision making. The research area is sited in the Lancangjiang river catchment of Yunnan Province in China, which composed of Jinghong Region and Simao Region. The eight counties are Jinghong, Menhai, and Menla which belong to Jinghong Region and Simao, Puer, Jiangcheng, Lancang, and Menglian which belong to Simao Region (Fig. 1). This area is adjacent with the other two countries of Burma and Laos, where is recognized as the

Fig. 1. Research areas

"Gold Triangle". Lancangjiang River catchment covers the three countries. System design for this project will refer information occupied by users in different levels. Standardization technology will be important for the multi-scale decision making spatial information system.

II. SYSTEM DESIGN

Geographic Information System (GIS) is changing to WebGIS or Internet GIS, which will be a very useful technology for distributed sharing spatial information for environmental planning and geospatial related application. Several organizations such as ISO/TC 211 [2], OpenGIS [3], and FGDC [4] are making geomatics standards for digital spatial information sharing. The procedures will be a hard way and many related standards could be finished in the following years. Anyway, users can not stop to wait for those standards and many application needs are continued. So a geospatial system should be established based on those

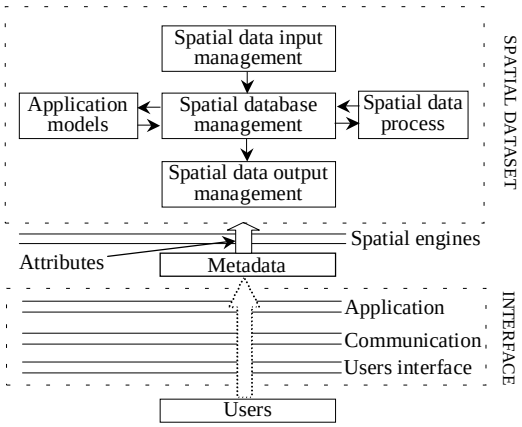

Fig. 2. Key modules for Spatial Information System based on Internet

standards or drafts.

Fig. 2 indicates the key modules for geospatial information system and the components used in the project. The spatial dataset is composed with spatial data process method and application models. The dataset will be integrated as a spatial database with input and output interfaces. The spatial dataset is connected with the Metadata system [5], which is used to visit the dataset via spatial engines using attributes. Users can get needed dataset information via user, communication, and application interfaces. The Metadata interface is designed based on both international and national metadata standards and profiles. This design technology can avoid the difference of data structures existing among spatial datasets. Sharing spatial information is only based on metadata standard and interface types. Thus, hard work such as establishing spatial datasets will have little change in standardized transfer if applicable for sharing in the future.

According to the system application demands, land resources, disaster monitoring, regional crops, trading, transportation, tourism, ecology and environment, hydrology, ore resources, and population subsystems are integrated in the system, which will be used in the corresponding departments and related users (Fig. 3). Subsystems are integrated into two application systems named networking information manage system and integrated decision system. The data is managed by professional servers with relationship to multi-sources information. For this reason, data organization will influence the system efficiency and application.

III. Information Organization

Data from different sources such as basic paper maps and thematic maps, statistics data, graphics databases, remote sensing and aerial photographs exist in the research area owned by different departments. Data acquiring and collecting is supported by the government of Yunnan Province and the research regional governments. Three data interfaces are used for information organization based on application demands such as data forms, scales, and regions. The interfaces which are linked to professional databases established for the project and the analysis results acquired based on those databases can be distributed via the Web (Fig. 4).

In order to satisfy the application demands and system

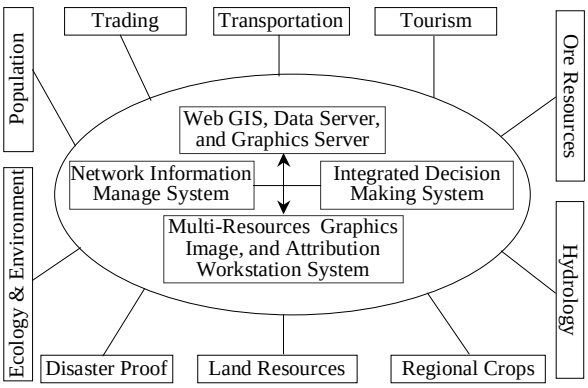

Fig. 3. Lancangjiang Catchment regional development and planning information management and decision making system.

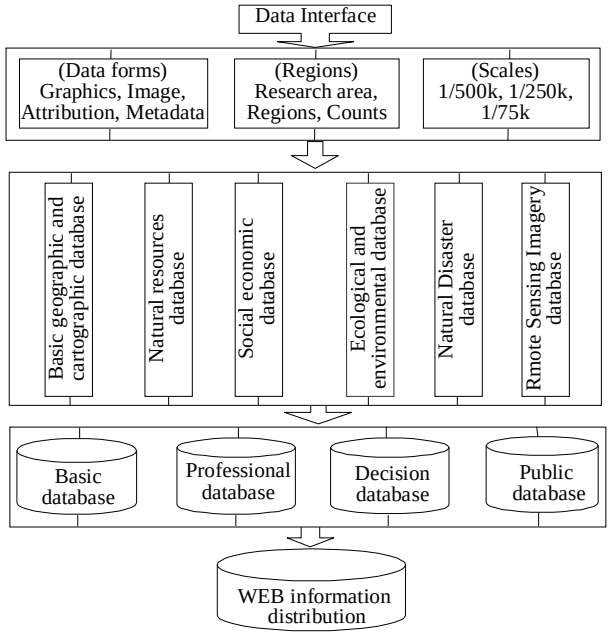

Fig. 4. Database Architecture

security, three types of Internet, Intranet, and Local users are classified in the project (Fig. 5). The users capability to visit and obtain typical datasets is strictly confined in the system. Therefore, only users in the information center have the priority to maintain and renew professional information. Users in other places of the province and outside the province may use the information based on their visit restrictions. General users will be allowed to visit and use public datasets in the system.

Databases establishment are based on different subprojects. Maps and images such as multi-scales and multi-periods are used for the shortage of information sources. So, in this procedure, some standards are set to normalized data sources. As a result, a Web site based database and an information center based database are finished.

IV. System Implementation

Different software packages are used for the system.

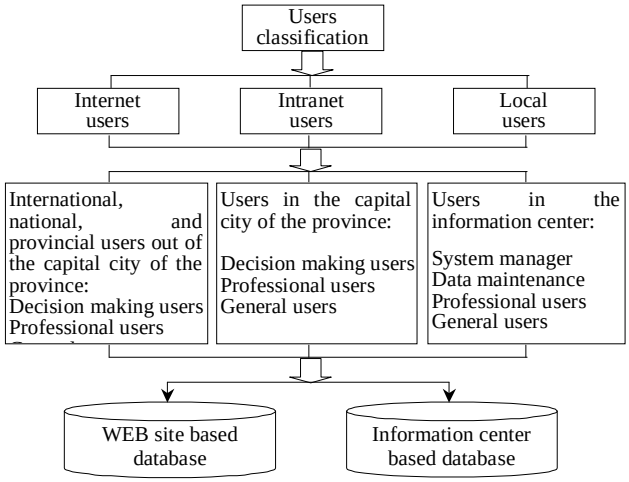

Fig. 5. Users classification for the spatial database

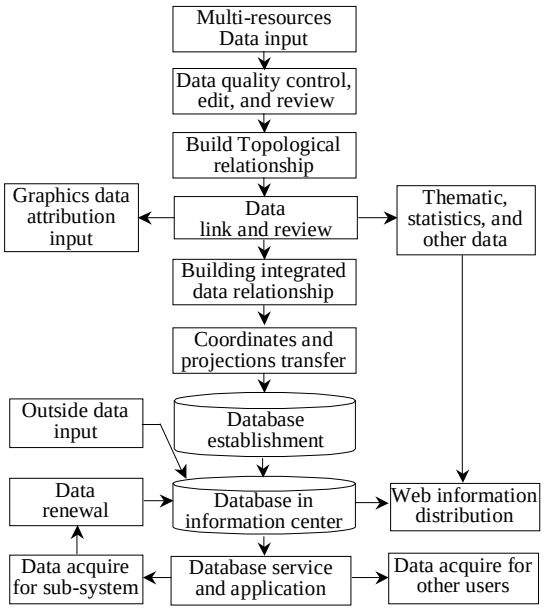

Fig. 6. Database flow chart

Application interfaces and models are finished with Visual C++ and Visual Basic.

In order to easily integrate multi-source data into the geospatial system, Arc/Info package is selected as the basic platform for spatial information preprocess. The ArcView package is used for information integration with statistics data such as trading and population data. Standard dataset attribution codes are designed for information processing and linkage between spatial and statistics data [1]. Subprojects are all limited on this standardized attribution codes and subsystems are implemented by the corresponding groups.

Application Interfaces are allowed to be implemented with Visual C++ and Visual Basic languages. Then WebGIS based software Geomedia is accepted for information application via the Internet. The integrated system can be run by users via the WebGIS engine using a general browser such as Netscape and Internet Explorer.

Application departments consider more regional information, such as governors in the counties of Simao Region will consider little information about those in Jinghong Region, but governors in Yunnan Province or other macro-departments will consider both situations in the two regions. Therefore, the integrated system is also divided into application subsystems based on these reality demands.

Fig. 6 is the data flow chart of the system. The multi sources data will be controlled by series procedures such as quality, projections, and linkage among different datasets. After the database is established, it can be acquired and used by subsystems and users.

Fig. 7 refers to the sample application methods whereby users get information into the system. Clearly, the spatial and statistics database can be used for sustainable development, planning, environmental protection, and hazard or disaster diminishing, etc. Those applications are supported by different databases such as knowledge, models, resolutions, and professional GIS etc. are included in public databases

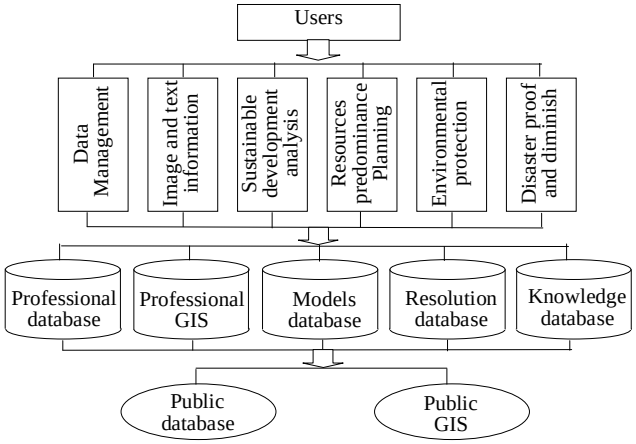

Fig. 7. Integrated analysis architecture of subsystems

and public GIS. Thus, the system established with multi-sources and multi-levels with standardization design technology can be used by users via the network according to their visit limitations.

V. Conclusions

Large scale spatial information system design technology is complicated work based on different information sources and demands. Shortage of spatial data standards or drafts is a big problem for system establishment which may result in considerable duplication or hard data transfer burden in the future. The spatial data standards and drafts used in this project are based on ISO/TC 211, FGDC, and Chinese National Geomatics and other standards and drafts. The pilot spatial information system design technology used in this project demonstrates that although united system design method is difficult to obtain, using international and national standards or drafts will be a popular way for digital spatial system establishmen. As a result, a useful web based geospatial system can be established and applied in environmental planning and decision making system for regional management.

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