Applications of Geographical Information System in E-Government

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INTRODUCTION

Geographical information system (GIS) is one kind of information system that handles spatial data. It is difficult to give one definitive definition about GIS (Heywood, Cornelius, & Carver, 2002; Maguire, Goodchild, & Rhind, 2001). This variety of definitions can be explained by the fact that any definition of GIS will depend on who is giving it, and their background and viewpoint (Pinkles, 2002). The complete definition of GIS is selected here as: "a set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purposes"(Burrough, 1986, p. 6). As an important part of e-government, is that it has functions of cartography, manages spatial data and spatial analysis.

BACKGROUND: THE ROLE OF GIS IN E-GOVERNMENT

All types of data are needed in e-government, among which spatial data are perhaps the most important information, reflecting the distribution rules of spatial entities (e.g., property boundaries, roads, etc.). Therefore, e-government cannot do without GIS, and therefore, the management of e-government cannot be successful without analyzing spatial information. With the advantage of handling spatial data, GIS can provide many services concerning spatial analysis, such as, geographical location information, location-based services, route tracing, and the analysis of spatial structures. This can be especially valuable when incorporating social and economic attribute data.

Functionality of GIS in E-Government

There is a wide range of functions for data analysis available in most GIS packages. According to the top-down hierarchical classification of the major types of functions that characterize GIS, there are ten major categories to define the functions of GIS: capture, transfer, validate and edit, store and structure, restructure, generalize, transform, query, analysis, and present (Dangermond, 2001; Maguire & Dangermond, 2001). In any GIS project, not all of the GIS functions or even all of the major categories need be employed. Generally, with the functions like measurements, attribute queries, buffering, map overlay, spatial interpolation, analysis of surfaces, and analysis of networks, GIS can provide mapping, spatial data management, and many other functions for various managing in public sector.

For example:

- GIS could handle and provide relative maps. Since GIS provide spatial information with maps, it can make the necessary information much clearer and obvious at first glance.
- GIS can collect, handle, store and manage spatial data. Managers can obtain more complex spatial information for making decisions through query functions of the system.
- Spatial analysis function of GIS can be used in simulating and analyzing (creating what if scenarios) of the stored spatial data. With GIS software, various description programs for spatial processes are provided as decision-making support system for management.

Applications of GIS in E-Government

GIS can play a role in all aspects of spatial information management. In governmental management, GIS application becomes more and more intensive. Some cases are shown next to illustrate applications of GIS in governmental management.

- **Regional (or Urban) Planning—Both General and Physical Ones:** By combining graphic and property information effectively, GIS can provide immediate

and bidirectional data operation. This can provide services such as inputting map data, editing topographic map, setting up attribute data and querying planning information. With the proper system, both general urban planning and physical plans can be created, as well as comparing and simulating the different results of the planning. Meanwhile, GIS can provide assistance via decision-making support tools for selecting land blocks, examining and approving architecture licenses, evaluating demolition and relocation projects. Most importantly, the planning programs can be described by maps.

- **Land Management—Managing Land Resources, Land Record, Land Classification, and land Using:** All the land management process can be fulfilled by operating spatial data stored in GIS. Generally, GIS provide tools such as data inputting, querying land block alteration, analyzing land quality, and automatically measuring land areas for the end users. When doing land management, GIS can also be integrated with office automation (OA) system into an integrated land management information system, which involves many subsystems such as data handling, windows office, and cartography, and so forth. With the system, the users can query the distribution of land resources, alter the record of stakeholders, and make land use plans in the network.
- **Municipal Facilities Management—Managing Pipelines of Water, Electricity, Gas, and so forth:** By combining pipeline databases of municipal facilities, customer location information and property, GIS can provide graphic displaying and query functions for managers and inspectors; by using network analysis model and information about valves and switches of municipal pipeline network, GIS can provide inspection data and emergent repairing programs for work process handling, detect field construction, and analyze the areas where there are, or have been failures or that are prone to failure in the pipelines.
- **Traffic Management—Managing Vehicles and Roadways:** Constructing city traffic information system with GIS, the system can query and analyze the traffic conditions through spatial and attributes data. At the same time, the system can be connected with other equipment, such as road sign controllers, vehicle information systems and global position systems (GPS), etc. In this way, close loop control system is created to manage traffic information, roadways situations, and vehicles effectively.
- **Hazard Monitoring and Controlling—Emergency Management:** A large variety of data elements involved in the assessment of risk and emergency management can be collected by GIS. Once a database of potential hazards has been set up using GIS tools, specific hazards or emergency situations can be displayed by query and other spatial analysis functions of GIS. The system can also help to make special assessments for emergency preparedness by being integrated with social-economic and traffic databases (and other data), assisting in making the decisions for response, and for the process of recovery.
- **Real Estate Management—Managing Housing and Property:** By using GIS, we can manage data of district boundaries, street networks, municipal facilities, architecture, and the various types of public facilities, as well as the characteristics of private properties in order to make good housing policies. For example, providing more housing opportunities for poor people, etc. GIS has very rich functions such as editing, developing overlays and creating complex displays from disparate data. As a result, property information, housing age, housing prices and surrounding infrastructure information can be queried using GIS tools. In addition, the spatial analysis of building locations or property alterations can be done by setting up many kinds of analytical models.

KEY ISSUES OF GIS APPLICATION IN E-GOVERNMENT

GIS applications will meet various issues in different governmental sectors. Because the governmental roles are multi-sectored and complex, the system has to manage the different data formats, and operate in various environments in order to meet data sharing and exchange requirements between different sources. Therefore, interoperability of spatial databases, the unification of multi-department application systems, and integration of GIS into management information systems (MIS) and other non-spatial systems are critical issues in GIS application.

Interoperability of Spatial Database

Managing spatial data is the key issue of GIS application. Many kinds of GIS software have been employed over time and some remain as legacy systems. In some cases, software was independently developed. There are lots of differences among these various GIS software platforms, especially because of various data formats. As a result, some data might be lost when it is used with software it wasn't designed for. Hence, data sharing between GIS