INFORMATION MANAGEMENT FOR ENVIRONMENTAL PROTECTION IN TAIWAN

Howard S. H. Chen and Yu-Chi Chu
Environmental Protection Administration, Executive Yuan
Taipei, Taiwan, 10014, Republic of China
Email: {shchen, ycchu}@adm.epa.gov.tw

ABSTRACT

The purpose of this paper is to discuss the strategy of information system development and management for environmental protection from Taiwan's perspective. Environmental protection has become Taiwan's most urgent problem in recent years. Since the environmental problems are multi-faceted, their management requires consideration of a number of issues, such as sustainable development of resources, the balance of multiple values, spatial analysis, and so on. To address these requirements, information systems and databases are becoming more and more important. The Environmental Protection Administration's experience in information system development is hereby described. It indicates that the use of computer technology in environmental data management and analysis has benefited the R.O.C. Environmental Protection Administration in the past years. The new prospects of information management for environmental protection in Taiwan are discussed. Since environmental management places heavy emphasis on spatial data and analysis, the detail discussion in this paper focuses on geographic information systems and related issues.

INTRODUCTION

Taiwan, one of the larger islands in the southwest Pacific archipelagoes, lies off the southeast coast of mainland China to the North of the Philippines and is primarily a mountainous island with a total area of thirty-six thousand square kilometers. For the last four decades, Taiwan has rapidly transformed from an agriculture-oriented nation to a highly industrialized modern society through the endless effort of the government and the people. The rapid economic development that has taken place in Taiwan has resulted in some undesirable side effects, such as an accumulation of solid and hazardous waste, air and water pollution, and destabilized natural resource systems. While the Taiwan government has taken note of the situation in recent years, many efforts remain to be made to clean up the environment. To create a better living environment, the government is seeking new technologies to improve environmental monitoring and modeling skills. Information technology is one of the technologies that can improve the quality of decision making and raise the level of efficiency in respect to environment issues.

The Bureau of Monitoring & Data Processing (BMDP) has been established within the Environmental Protection Administration to carry out the mission of collective planning for evaluation of environmental quality on a nationwide scale and for the establishment of an information management system. The official duties of the bureau on information management issues are as follows:

1. To integrate environmental quality monitoring and data processing, so as to further establish a decision making support system and to become an instant inquiry center for nationwide environmental protection activities.

2. The establishment of a nationwide Environmental Protection Administration Information System and Environmental Protection Databases.

OVERVIEW OF THE CURRENT STATUS

Hardware/Software equipment

The administration employs the VAX 6420 system that is connected to 66 air monitoring stations around the island. Oracle RDBMS is used for monitoring data management. Most information systems that support the daily work of the administration employ an IBM 4381 system with FOCUS DBMS. Also, a Netware PC-LAN which is attached to about 120 PCs (to be expanded to 300 PCs by Dec. 1994) provides a data sharing environment. Software packages such as spreadsheets and word processors are widely used in the administration offices.

Since the geographic information system (GIS) can provide a powerful environment for the management and integration of various kinds of data, the administration uses HP workstations and an ARC/INFO package as a platform for the development of GIS applications. Attribute data and spatial data are closely managed by ARC/INFO software.

Framework of the system network

Owing to the extensive nature of environmental protection issues, and the urgent need for swift and accurate information, a Nationwide Environmental Protection Information Network (NEPIN) was established to meet the occasion. Through a Digital Telecommunication Network, the NEPIN allows the department of environmental protection of the provincial Government, Taipei and Kaoshung Municipal Governments, the environmental protection offices in various cities and counties, and relevant academic institutes, to exchange information. In June of 1994, the EPA also established a link with the Internet. Through the network, the administration can communicate with ironmental protection institutes in more than 120 countries on environmental protection issues.

Information systems for environmental protection.

Based on the IBM/BSP (Business System Planning) methodology, a framework of the environmental protection information systems (EPIS) was built as a blue print for long-term development in 1989 (Environmental Protection Administration, 1989). The EPIS, covering databases for environmental quality, pollution control, basic environmental data, and administrative support, consists of more then 20 subsystems at present.

Some of the specific information systems, such as environmental CAI and the regulation retrieval system, were developed to assist in environmental education and policy planning. Also, the administration implemented an air quality monitoring information system that was dedicated to dealing with the gathering of data from 66 air monitoring stations.

Since 1991, the administration has begun to promote business with the technology of GIS and was in charge of the planning and convening of nationwide environment quality databases for the national GIS project in Taiwan. We have made some remarkable achievements in spatial data collecting and application implementation at present.

Since many of our information systems are for functional development and not well linked, we have made an integrated plan to improve the current status. Some strategies in the plan are as following:

1. Constructing an integrated environment geographic information system (EGIS)
The environmental management places heavy emphasis on spatial data and analysis. We will develop an integrated geographic database that could communicate well with other databases (Chen and Chu, 1994). Several development guidelines are as following:

   i. Multisource data acquisition. The first steps in developing the database for a geographic information system are to acquire the data and to place them into the system. Data to be inputted to a GIS are typically acquired in a diverse variety of forms and EGIS must be able to accept a wide range of kinds and formats of data. For example, we employ GPS technology to locate the location of pollution sources, and we also utilize remote sensing data to get information about properties of the Taiwan's surface over a large area. The categories of data in EGIS database are shown in figure 1.
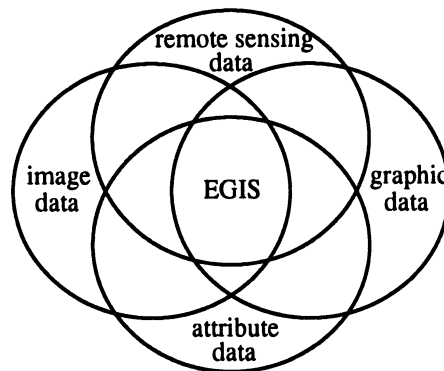

Figure 1: The categories of EGIS data

   ii. The standards of EGIS. The standard of EGIS is one of the most important issues. All EGIS applications must be implemented in accordance with appropriate standards for software, hardware, data and other components. The EGIS standards that need to be established include:
● Classification and encoding system for environmental data
● Symbols and legends for map features
● Data interchange formats
● Data qualities and its evaluating procedures
Other standards consideration might include: spatial data management system, software programming language, queries language and so on. The administration should also use existing practical experience with other agencies in Taiwan (e.g. Ministry of Interior, The Research, Development and Evaluation Commission), industry and academia to develop standards that promote the effective use of GIS technology and facilitates access to GIS capabilities by program offices. All EGIS standards should fit the demands of National Geographic Information System (NGIS) project which started in 1990 by Executive Yuan.

iii. _Mission-based application system implementation_. The implementation of EGIS application systems should be fitted for the objectives and activities of program offices in the administration. In beginning to implement a EGIS application, a thorough analysis of system requirements should be done by BMDP and program offices. It also should identify what are the anticipated benefits of the application systems (e.g. workload, decision-supporting, and enhanced management).

Since GIS is a dynamic system, a detailed planning for data updating and revision should be carefully evaluated before the implementation.

2. Constructing a nationwide environment information network

Architecture of the current NEPIN will be renewed and a nationwide environment information network will be constructed. The administration will try to link with all the environmental protection offices in various cities and counties around the island via TCP/IP through X.25 protocols. In the administration, we will construct a client/server environment to suit the needs of individual departments and users. We will also try sizing down some applications in the mainframe to the LAN-based platforms.

3. Promoting environmental information exchange using EDI technology

Electronic Data Interchange (EDI) technology has recently changed the way of environmental data can be managed and exchanged. The administration is currently pursuing constructing a framework for the needs of international and local environmental data exchange (Environmental Protection Administration, 1993). Following is a brief description of the two future directions:

i. Define the Environmental Protection EDIFACT message standards to facilitate environmental quality data interchange. The administration will work with other countries to promote an international standard.

ii. Apply the EDIFACT message standards defined in (i) to establish a system for the exchange of air quality reports of pollution sources.

4. Establishing software quality assurance procedure

The function of software quality assurance (SQA) is to be responsible for uncovering bottlenecks to the achievement of quality and uncovering product and process defects (Deutsch and Willis, 1988). Software systems and the environmental problems they solve are increasingly complex. The administration promotes synthesizing software development techniques into an engineering discipline. Some issues of software development will be changed and enhanced, such as:

- Software development management
- Formal qualification test
- Software product evaluation
- Software configuration management

CONCLUSIONS

Economic development in Taiwan has resulted in complex environmental problems. Due to the complexity of these problems, we need the ability to gather and manipulate immense amounts of data in an effective way. The R.O.C. Environmental Protection Administration is just beginning to address the question of distributing and integrating its information management system. New hardware and new software continually provide

opportunities for doing things better and more efficiently. Yet many challenges still await us. The administration will cooperate with other government agencies, environment management experts and researchers to create a shared-data, integrated information environment to improve the effectiveness of environmental protection programs and subsequently improve the quality of our living environment.

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