

THE INSTITUTIONAL CONTEXT OF GIS:
A MODEL FOR DEVELOPMENT

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ABSTRACT

The institutional context in which GIS operate has failed to evolve with either the rate of software and hardware developments, or the numbers of systems installed. This realization has been dawning on the GIS community over a number of years, and has led to studies such as the Wisconsin Land Records Committee and the Minnesota Inventory of Mapping Systems. The failure of institutions to evolve in the context of GIS is rapidly resulting in costly and repetitive efforts in database development and expertise at all levels of government, and in other areas. In this paper we will present a generalized model for the idealized institutional setting of GIS. The model is independent of implementation and could be realized in a continuous spectrum of contexts from fully manual to fully automated, and in size from Federal Government to small city or private company. The main elements are a central database with catalog and coordinating organization, access by as many users as require, secure databases for users if needed, and the implementation of standards.

INTRODUCTION

In most organizations the implementation of Geographic Information Systems (GIS) has been haphazard, and within any one organization any number of subgroups may be operating GIS, of one form or another. This potentially unorganized proliferation has been demonstrated or at least suggested in a number of recent surveys (Craig, 1988; DeMers and Fisher, in prep.; Wisconsin Lands Records Committee, 1987). While the importance of distributed systems and distributed responsibilities has been recognized, they are primarily considered to be a technical issue of database design (e.g. Webster, 1988). Organizational and Institutional issues tend not to have been addressed. This paper discusses a model for the operation of GIS within an organization of any size, and irrespective of either hardware or software.

BACKGROUND

The use of GIS is now widespread among many types of organization in both the public and private sectors. More often than not, this situation has evolved through the progressive implementation of small scale systems within sub-groups (departments) within the organization. Frequently the situation will arise in many organizations when a number of departments are operating GIS, using different hardware and software, but often employing the same databases, or at least having data types in common. These data types have usually been digitized in common.

A CASE STUDY

In a recent study of GIS within state government in Ohio, DeMers and Fisher (in preparation) found four systems operated by the Ohio Department of Natural Resources (ODNR), the Ohio Environmental Protection Agency (OEPA), the Public Utilities Commission of Ohio (PUCO), and the Ohio Department of Transportation (ODOT). The first two of these are primarily concerned with natural resource analysis, while the latter two have been developed for facilities management. The four systems all use different software, hardware and databases. Nothing is held in common, although there has been some communication among the groups, and occasional transfers of data have been conducted. Within the databases of all four organizations, however, political divisions, the drainage network and some form of the road network have been digitized separately (although to different levels of resolution). Several other data types occur in more than one of the four systems.

The situation in Ohio is not untypical, and even within that state's governmental organization it is known that a number of other departments are currently exploring the potential of GIS. Systems are also being implemented in a number of cities within the state, including both the largest, namely Cleveland, Columbus and Cincinnati, and smaller ones such as Akron, Kent, Medina, and so on. At present, there is no framework, organization or even individual through which existing or potential systems may interact. The potential for repeated collection of the same spatial data is enormous, and since the data collection phase is undoubtedly the most costly in establishing most GIS, redundancy in this phase may represent a considerable drain on the public purse.

A number of factors must be considered in suggesting any steps towards reducing the cost of digitization by data sharing. First, within the organizations reviewed, there was considerable concern for data security and confidentiality. Thus OEPA considered that they held highly sensitive data which would not be appropriate for

public examination, and PUCO believed that several utilities would be unwilling to share data if it had not been confidential. Second, each GIS operation considered that it was fulfilling a function of considerable utility within its own department. Finally, it is necessary to recall that the different departments have very different roles, and the different systems are used for different functions. Thus ODOT and PUCO are involved in facilities management, while OEPA and ODNR are natural resource management systems. Furthermore, ODOT has regulatory control over the state road network, OEPA regulates and monitors environmental impacts, and PUCO is concerned to monitor the activities of utility companies. ODNR, on the other hand is involved in inventory of natural resources and advising on their exploitation.

A MODEL FOR INSTITUTIONAL REVISION

Within Ohio state government, and in many other organizations, GIS implementations are at present operating in isolation, without any official form of contacts among the different groups. To prevent redundancy in data collection and in expertise institutional revision is required. Figure 1 presents a model of a form of interaction which involves a number of features intended to be sensitive to the requirements of different departments, as well as to the need to share data and expertise. The model is, however, independent of both software and hardware used by the different GIS operations, and may be implemented in a number of ways.

The model has a number of features:

1. A central base of statewide spatial data. All data types are available to all users. The Central Database itself has a number of parts:
 - a) Central Catalog where information is held on all data types made available by the participating organizations;
 - b) Collections of data for which responsibility is clearly targeted to a particular organization.
2. Some number of operating GIS (four exist in Ohio at present) each of which have:
 - a) a secure database of information that is considered confidential for that GIS operation.
3. Rigorous implementation of standards to facilitate data transfer (American Cartographer, 1987).

The model can be implemented at almost any level of automation and of standardization of hardware and software:

- 1) At the most automated, the system could involve a number of users of a central GIS, all users operating on the same computer system, with local workstations, and using a single software package. In some respects this is the most logical form of implementation.
- 2) At one level down, the participating GIS operations could each operate stand alone GIS each with different software and hardware, but connected by a network. The catalog would be maintained by a central organization, but the data could either be held by that organization, or by the individual GIS operations, simply marking data as secure or open.
- 3) The least automated version of the system would have no actual central database, and no network of interaction. Data types that operations are prepared to share would simply be transferred manually on tape or disk form the originating GIS to a user.

In short, the catalog of data digitized and the details of that data contained in the catalog (as specified by standards) are central to the model. Maintenance of that catalog will allow users to identify when particular data for an area has been previously digitized and at what resolution digitizing took place, and so establish whether the data may be useful to them, in place of redigitizing the information.

CONCLUSION

A model of how a network of GIS operations might be arranged has been proposed. The arrangement is particularly sensitive to two concerns expressed here: First, that where desirable data security should be assured, and second that the risk of data redundancy within the organization should be minimized. Further, the model can accommodate any number of different software packages, and can be implemented at a number of levels of automation.

ACKNOWLEDGEMENT

We wish to thank all those who assisted us in the review partially reported here, namely Tom Beard, Wayne Channell, David Crecelius, Charles Groves, John Helms, Gail Hesse, Ava Hottman, Gene Johnson, and Terry Wells of the various Ohio governmental organizations.

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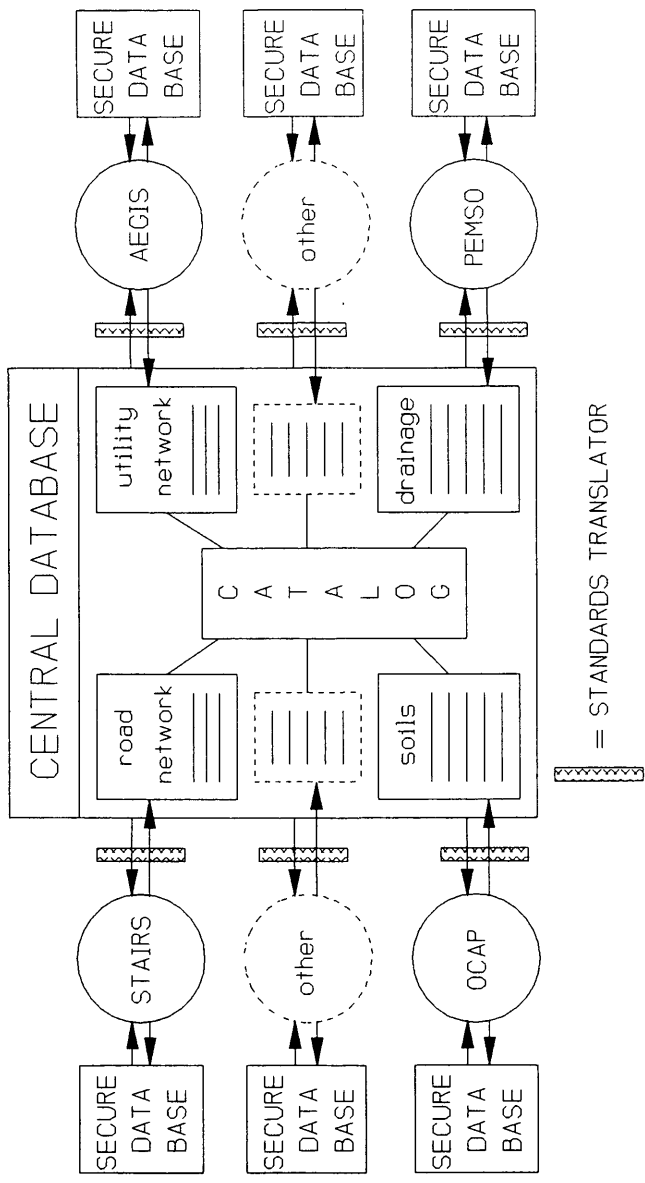


Figure 1

Diagrammatic representation of the model for development within organizations using a number of GIS installations.