



Chapter 4

Designing End-User Geographic Information Systems

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Geographic information systems are becoming more popular for end-user and decision support system construction, but they incorporate software and concepts with some inherent problems for users not trained in concepts of geography and cartography. This paper identifies those concepts most needed for end-user GIS use, and suggests remedial efforts to reduce the burden of system operation and improve data integrity. The approaches make extensive use of metadata storage and may be implemented as tools in GIS software provided to end-users.

... designers should start with a clear sense of and respect for the tasks that end-users will be doing, and then design a system that best supports those tasks.

(Bonnie Nardi, 1993, p. 125).

Geographic information systems (GISs) are a specialized class of database management systems that allow users to analyze, relate, and display spatial attributes of data in addition to conventional relational data. While best known for their ability to display data in maps, GISs also provide extensive analytical capabilities, especially for the analysis of data based on geographic location. In many ways, the use of GIS software by end-users parallels the end-user experience

in general, except that there is a decade-long lag between the two. The technology to deliver computerized spatial analysis and mapping to end-users has only been available since the early 1990s, and some of the most important end-user oriented technologies have only been introduced in the past three years.

In one sense, most previous writings on end-user computing (EUC) apply to end-user GIS use. GIS are computer programs that promote individual or group decision making, use data (including data in client/server or data warehouse environments), and have interfaces. Further, GIS technology may or may not be appropriate to the task at hand. Research in these areas will, in general, be applicable to the relevant aspect of GIS usage. This is not to say, though, that previous writings on end-user computing provide a complete prescription for the use of GIS by end-users. In particular, there is a gap in the end-user literature that is unique to the use of GIS.

Effective GIS use for decision making requires expertise in the user's decision-making domain, basic computer skills (file management, editing, etc.), and database skills, all well researched themes in modern end-user computing. GIS use also, however, requires the application of specific knowledge from the fields of geography and cartography, instances of "specific skills" as discussed by Aggarwal (1998). In the past, when GIS users tended to be scientists, engineers, city planners, etc., this specialized knowledge was included in the user's domain knowledge. As GISs become more widely applied to decision making in businesses and governments—where the domain expertise does not include the necessary cartographic knowledge—the ability of end-users to make effective use of these tools is limited.

This paper addresses this issue by providing prescriptive guidance for the support of end-users of GIS technology.¹ The next section provides some additional background on GISs and discusses the relevance of GISs to end-user computing. This section concludes with a list of four specific issues related to the use of GISs by end-users for which specific support is required. The following section presents an overview of the use of metadata as a tool for supporting end-user use of GISs and the final four sections discuss each of the specific problem areas in detail.

GIS AND END-USER COMPUTING

This section has three important roles, each of which is presented in its own subsection. First, an overview of GIS technology is presented. This overview introduces the technology to those unfamiliar with its use, and serves as a necessary foundation for the identification of the specific end-user support issues discussed later in the paper. Examples presented here are referenced throughout the paper. The next subsection expands on the introductory remarks regarding the pertinence

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