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Chapter VII

GIS as Spatial Decision Support Systems

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Abstract

This chapter discusses the use of geographic information systems (GIS) for spatial decision support systems (SDSS). It argues that the increased availability in spatial business data has created new opportunities for the use of GIS in creating decision tools for use in a variety of decisions that involve spatial dimensions. This chapter identifies visualization and analytical capabilities of GIS that make such systems uniquely appropriate as decision aids, and presents a conceptual model for measuring the efficacy of GIS-based SDSS. The discussions on the applications of SDSS and future enhancements using intelligent agents are intended to inform practitioners and researchers of the opportunities for the enhancement and use of such systems.

Introduction

Geographic information systems (GIS) have been used by government agencies, researchers, and business as a tool to support a wide range of decisions that have location dimensions (Groupe, 1990; Wilson, 1994; Dawes & Oskam, 1999). Over the last 10 years, the popularity of using GIS among business organizations has increased due to a number

of factors: (1) the belief that the use of GIS would improve decision making (Attenucci et al., 1991; Bracken & Webster, 1989; Dennis & Carte, 1998; Murphy, 1995; Robey & Sahay, 1996), (2) the fact that about 80% of data used in making business decisions has geographical dimensions (Worrall, 1991), (3) the increased availability of spatial data (Gagne, 1999; Heikkila, 1998), and (4) the availability and declining cost of the required hardware and software. Furthermore, with the ever-increasing popularity of the web and improvement in its technologies, web-based GIS are widely available to web-users in helping them in making decisions involving geographic information or *spatial decisions*. Like traditional DSS, the bottom line of using GIS is to improve the quality of decision-making. The issue explored in this chapter is the role of GIS in decision-making and its impact on improving decisions with spatial dimensions.

In examining this issue, we will briefly discuss the nature and functionalities of GIS, and contrast the parallel development of GIS and IT technologies and their main foci in order to bring out the aspects of GIS helpful in various decision-making tasks, hence making a case for spatial decision support systems (SDSS). Next, we discuss the critical role of visualization in decision-making as an important cognitive aid. In contrasting the nature of visualization in traditional DSS and SDSS, we highlight the potential contributions of SDSS in decision-making. We then report on the existing research in the use of GIS in business and note the absence of a theoretical framework for evaluating the efficacy of SDSS. This gap motivates the conceptualization of a theoretical-based framework for evaluating the efficacy of SDSS, which is presented next. The chapter ends with a discussion of the existing limitations and future directions.

Nature of GIS

Before we get into the discussion about the role and impact of the GIS in the spatial decision-making process and its impact on improving such decisions, we first need to discuss the nature of GIS and the unique features that make it different from traditional IT used in business. Although there have been a number of attempts to define GIS, there is no consensus about a single general definition of GIS. Most definitions are focused on either the technology or on the problem solving aspects of GIS (Malczewski, 1999).

The confusion about the definition of GIS may be due to the evolution and the diffusion of the technology. During the 1960s, the early GIS were initially developed to better manage geographic information by providing tools for the storage, retrieval and display of both spatial and attribute information in the form of maps, tables and graphs. The development of GIS applications can be traced back to Canada Geographic Information System and software from the laboratory at Harvard University. The early GIS such as SYMAP and ODYSSEY developed in the Harvard lab were applications used to produce geographic representation or maps with simple functionalities such as the overlay function. The outputs of the system were in the form of simple maps that were produced off-line. As the GIS technology progressed, various disciplines adopted the technology for their own specific purposes in order to take advantage of the flexible capability to visualize geographic information. Some GIS definitions reflect these limited capabilities of GIS, such as the definition by Burrough (1986) that GIS are a set of tools for collecting,