Chapter 29

Development and Application of a Spreadsheet–Based Spatial Decision Support System (SDSS)

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ABSTRACT

Spatial decision support systems (SDSS) are decision support tools which have been used widely in addressing complicated issues involving a spatial component. The use of SDSS has increased greatly over the last few decades especially in fields such as planning, natural resources management, and environmental science. Traditionally, SDSS have been developed with Geographic Information Systems (GIS) technology as a major component and used in application areas in which the use of GIS technology has been common. GIS software is often expensive and requires significant expertise, which can lead to under-utilization of GIS-based SDSS. In this paper, we describe the development of a freely available SDSS extension developed for Microsoft Excel, a very commonly used spreadsheet application. The purpose of this SDSS is to expand potential SDSS use to a wider potential audience for research, management, and teaching purposes.

INTRODUCTION

Spatial decision support systems (SDSS) are decision support systems (DSS) which utilize geographical or spatial data. Sugumaran and De-Groote (2010, p. 14) defined SDSS as "integrated computer systems that support decision makers in addressing semistructured or unstructured spatial problems in an interactive and iterative way with functionality for handling spatial and nonspatial databases, analytical modeling capabilities, decision support utilities such as scenario analysis, and effective data and information presentation utilities." Research on SDSS has been strongly

influenced by that of DSS (Malczewski, 1999) and has followed advances in geospatial technologies; especially Geographic Information Systems (GIS) software advances (Sugumaran & DeGroote, 2010). The use of geospatial techniques and technologies such as GIS, remote sensing, and Global Positioning Systems (GPS) has grown tremendously over the last several decades. As Keenan (2006) pointed out, many phenomena have a geographic component which can be captured, described, and analyzed in GIS which has led to its playing an important role in a wide range of fields. The development and utilization of SDSS technologies grew tremendously from the mid-1990s based on the number of articles published on the subject (Malczewski, 2006; Sugumaran & DeGroote, 2010). This followed a similar trend in the uptake of geospatial technologies. Drivers of this increased use were more powerful desktop computers, the development of GIS software with more friendly graphical user interfaces (e.g., ArcView (ESRI, 1996)), as well as built-in GIS development environments (e.g., Avenue which was bundled with ArcView (ESRI, 1996)).

The vast majority of SDSS applications developed to date have had GIS as a major component of the architecture. The architectures of SDSS have varied with some of them being developed entirely within the GIS software (embedded), some with a tight coupling (common user-interface) between GIS and other modeling or mutli-criteria evaluation software, or a loose coupling between GIS and other components through formatting and exchange of data files. In a review of SDSS composed of GIS and multi-criteria decision analysis (GIS-MCDA) techniques, Malczewski (2006) found that loose coupling of systems was the most common method of integration. Thus, the development and application of SDSS has generally required possession of GIS software and experience in using such software. While open-source and free GIS software are becoming more widely available, the majority of SDSS have been developed using commercial GIS software

which can range in cost from several hundred to many thousands of US dollars.

Due to the GIS-centric nature of SDSS, adoption has naturally occurred in disciplines which were also adopters of geospatial technologies. In a review of SDSS publications, Sugumaran and DeGroote (2010) listed the application of SDSS from most to least frequent being natural resources management, environmental, urban, agriculture, emergency planning/hazard analysis, transportation, business, utility/communications/energy, and public health. Malczewski (2006) found that what he classified as environment/ecology was the most common application area. Fields such as natural resources management were early adopters of GIS and remote sensing technologies. Other fields such as business and public health have been later adopters of technologies such as GIS and thus have had slower uptake of SDSS. Some of the reasons for lack of adoption are the lack of spatial data knowledge of the users, lack of training and education for these technologies within their fields, and the expensiveness of GIS systems. Uran and Janssen (2003) analyzed five SDSS applications and found one of the major drawbacks to effective use was that they required a high level of GIS expertise in order to carry out operations in the SDSS. They specifically indicated that the outputs of the model (spatial data) still required further spatial processing in order to properly evaluate results. This type of situation limits effective use of SDSS to GIS experts.

Although spatial data processing, analysis, management, and visualization functionality are often essential for SDSS, a given SDSS often utilizes a mere fraction of the tools available in GIS software. However, as the GIS software have been developed to offer a wide-range of functionality for use in many disciplines, the interfaces and tools will not necessarily be intuitive for non-expert users. Thus for many SDSS, unless the users are experienced GIS users, or the developers invest in the careful design of user interfaces and tools for ease of use, the SDSS might be under-utilized.

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