

SDSS Based on GIS

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INTRODUCTION

The landscape is very limited resource nowadays. Therefore it is very important to recognize its potential and optimize the landscape use. It is necessary to use the techniques of the spatial decision-making due to the complex requirements and the large number of criteria (environmental, economic, and sociological). This process involves the use of the spatial analysis methods and multi-criteria system analysis of spatial data for effective spatial planning.

BACKGROUND

Decision Support Systems (DSS) enable application of analytical and scientific methods in decision-making process. DSS is as a group of programmes that support decision-making (Batty & Densham, 1996; Brail & Klosterman, 2001). Originally, these systems were intended for financial planning where they were to become means for making estimates and evaluation of hypothetical development scenarios. Using 6 attributes to identify DSS:

- DSS are directly designed to solve problems difficult to structure;
- They represent an efficient and user-friendly environment;
- They are able to examine accessible solutions by creating alternatives;
- They enable interactive and recursive solution;
- They are able to flexibly combine analytical models and data;
- The system uses more decision-making methods (Densham, 1991).

Spatial Decision Support Systems (SDSS) are a special type of information system. There is no unambiguous and generally accepted definition because forms of technology have not been profiled yet (Brail & Klosterman, 2001). However, the majority of authors agree that it is a spatial expansion of DSS, or rather an integration of GIS and DSS (Densham, 1991; Eastman et al., 1995). Computer information systems that provide support for problems difficult to formulate and structure and cases when it is impossible to use a fully automated system are usually considered SDSS. SDSS are closely related to knowledge-based and expert systems whose creation was possible due to artificial intelligence. SDSS as a spatial expansion of DSS have four further attributes (Radke, 1995):

- They provide a mechanism for entry of spatial data;
- They enable representation of spatial relations and structures;
- They include analytical means for spatial and geographical analyses;
- They enable creation of spatial outputs, as well as maps.

Expert systems are computer programmes able to simulate actions of an expert in a particular field when solving complicated tasks. They are considered a sub-category of knowledge-bases systems (Brail & Klosterman, 2001). They are based on symbolic representation of knowledge and its implementation in an inference mechanism. Experts in the given field present the source of knowledge and procedures. These systems are able to justify solution procedures. They are used primarily for tasks difficult to structure and algorithmize, e.g. problems with recognition of situations, diagnosis of status, construction, planning, monitoring of status, corrections, management and decision-making. However, experience and intuition

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have to be part of the solution. Complete expert system is made of the following components (Poppere & Keleman, 1998): Basic component, which includes knowledge base, fact base and inference engine.

- Knowledge base is a set of data structures representing knowledge of an expert. This knowledge is expressed in such a way that the inference engine of the expert system can manipulate it. It characterises general and specific knowledge of a given area and ways of problem solving.
- Fact base serves for storage, complementation, modification, and possibly deletion, of data related to the given problem. These data are accessible to other programme modules of the expert system. The items of the fact base present a concretisation of the items of the knowledge base.
- Inference engine is the core of the whole system. It serves to evaluate the knowledge base using facts from the fact base. It enables communication with all parts of the system, as well as the user. By symbolic calculations it simulates the expert's ability to think. Inference engine can be perceived from three points of view. Outward point of view focuses especially on those functions that are perceived by the user when working with the system. Inward point of view focuses on those functions that are connected to its construction. Implementation point of view focuses on the function of the inference engine from the point of view of programming languages and programme environment.

Additional component consists of three modules. The communication model intermediates communication between the user and the expert system. The explanation module explains and justifies the status and progress of problem solving and the final result. The result generator ensures combining of partial results into whole units without excess information in the required format and in a comprehensible form (Brus et al., 2010; Poppere & Keleman, 1998).

ROLE OF GIS

Using GIS and SDSS has a characteristic feature: except for creating data structure, which tends to be the primary reason for deployment, specific decision-making methods are applied (Borough & McDonell, 1998; Markus, 2003). According to Keenan (2002) there are two basic categories of perceiving and using GIS as a tool for decision support:

- GIS is used for better decision support because it helps assemble, organise, analyse and appropriately visualize data used for problem solving by the user. When making a decision on the suitability of solution it is possible to make use of alternative scenarios and then compare their decisive parameters.
- GIS is relatively amply used in solving specific SDSS tasks oriented at location and allocation problems, as well as in network analyses.

Other authors also mention a similar view of GIS and SDSS. For example states that each GIS helps the user to perform better explanation or justification of his decision (Eastman et al., 1995; Massam, 1999).

However, at the same time, he sees a problem in lack of interconnection between GIS and decision-making methods in narrower sense. He perceives GIS as a means for interconnection of data bases with management processes and says that the spatial character of GIS makes it a system suitable for identification of various phenomena dependent on geographical space. It is three ways in which GIS can be used in a decision-making process (O'Looney, 2000):

1. GIS enables representation of problem in graphical/spatial form, thus leading to a more elegant solution of the given problem.
2. Using GIS changes our perception of the world and makes us realise the spatial context.
3. GIS as a strong tool of information processing can also be deceptive (intentionally, or not) by representing things that do not exist.

Systems for spatial decisions are applied in a number of different fields, especially in applied biological sciences. GIS application during decision support in

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