

GEOGRAPHIC INFORMATION SYSTEMS: AN OVERVIEW

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ABSTRACT

Geographic Information System (GIS) is an integrated information system that provides timely and quality spatial information for specific geographical applications. GIS ranges from a small piece of software programme to a highly complex and sophisticated integrated communications system. GIS is itself an integration of various specific subsystems. It also serves as an integration technology as it integrates knowledge from different disciplines and functions of various information technologies into one single system. GIS has been extensively used in government and private sectors for a number of scientific and non-scientific applications. Open GIS is the concept that provides inter-operability, extensibility and flexibility to this specific type of information system. This paper presents a generic definition of GIS from a broad perspective, the principal features and functions of GIS, and the application areas of GIS. The paper also includes a brief discussion on the integration technology concepts of GIS.

INTRODUCTION

Information systems have become an integral part of the information society today. Information systems support the information needs for the operations, management and decision making functions in an organisation, which include collecting, processing, storing, transmitting and displaying information in an effective and efficient way. Information systems are widely used in various modernised organisations for a

wide range of applications. The types of information systems that are frequently used to support the operations, management and decision-making functions include transaction processing systems, knowledge work systems, decision support systems and management information systems. However, this paper is concerned with the specific information systems called "Geographic Information Systems."

"Geographic Information Systems" is a collective, general term for describing information systems manipulating geographic data. Geographic information systems vary significantly from one to another, depending on the application domain. However, most geographic information systems have one thing in common: they were designed to provide timely and quality spatial information for specific geographical applications.

DEFINITIONS OF GIS

Generally, there is no universal definition for GIS. Different researchers presented definitions with different emphases on various aspects of GIS. In the broadest possible terms, geographic information systems are tools that are designed for processing geographic data into useful and meaningful information.

The United States Geological Survey (USGS) defines a GIS as "a computer system capable of capturing, storing, analysing, and displaying geographically referenced information; that is, data identified according to location" (Anon., 2003).

Gianfranco defines GIS as "an application software (user interface, general and specific

functions) that allows the input, visualisation, and analysis of geographic data (geo-references) or remote-sensing images." (Scrinzi *et al.*, 2000) DeMers defines GIS as "tools that allow for the processing of spatial data into information, generally information tied explicitly to, and used to make decisions about some portion of the earth." (DeMers, 2000).

Jeffrey defines GIS as "an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-reference data, as well as a set of operations for working with data." (Star and Estes, 1990).

Densham used the term spatial decision support system (SDSS) to describe a system that "... normally is implemented for a limited problem domain. The database integrates a variety of spatial and non-spatial data and facilitates the use of analytical and statistical modelling techniques. A graphical interface conveys information, including the results of analyses, to decision makers in a variety of forms. Finally, the system adapts to decision makers' style of problem solving and is easily modified to include new capabilities" (Densham, 1991). Most of the commercial GIS, particularly desktop GIS, fall into the definition of SDSS.

CONCEPT OF GIS

A Geographic Information System (GIS) is a special-purpose information system, which is designed to serve specific geographical applications. GIS supports the input, visualisation and analysis of geographic data (geo-references) or spatial information. GIS associates the graphical representation of each territorial element with its respective classification in reference to a specific chosen theme. The geographic data in a GIS are described and organised in layers, each representing a thematic characteristic with respect to a specific spatial region.

A comprehensive GIS is equipped with an input function that is capable of capturing geographic data from various sources (maps, aerial photos, satellite images and surveys), a storage function that is capable of managing the data (storage, retrieval and query), a processing function that is capable of manipulating the geographic data (transformation, analysis and modelling), and an output function that is capable of visualising the data in various forms (reports, maps, plans, spatial statistics, etc.).

GISs are often related to other database applications, but with a major difference where information in a GIS is linked to spatial references. This means that the database of a GIS uses geo-references as the primary means of storing and accessing information. A database application may use locational information (such as street, address or zip code) for manipulations, but a GIS database uses coordinates for manipulations.

GISs should be perceived as an integrated solution rather than a software or hardware. This is because GISs are often used for analysing situations and making decisions. The way in which data are entered, stored and analysed within a GIS must reflect the way spatial information will be used for a specific research or decision-making task.

CONCEPTS OF INTEGRATING TECHNOLOGY

GIS is a special-purpose information system that requires various specific data capturing and processing technologies. Hence, the development of GIS is more toward integrating the existing technologies into the system, rather than developing the entire system, which could be really costly and time-consuming.

The concept of integrating technology is important in the development of GIS. GIS integrates a number of discrete technologies into a whole, rather than being completely new. Therefore, GISs differ significantly from one to