Foreword

Spatial information systems were created manually for many years. For example, historically, the source of cholera in London in 1854 was found by John Snow, by mapping where victims of the disease lived. The graph clearly showed them to be close to the Broad Street Pump,[1] one of the city's water wells. Another example is Zipf's Law,[2] which predicted that a number of sociological phenomena. His regression model followed a straight line on log-log paper. For example, Zipf's law describes the rank of metropolitan statistical areas (SMSAs) in the census of cities over 2,500 plotted against their population, or, for that matter, the number of copies of a St. Louis newspaper bought in suburbs out to 150 miles.

What is new in our computer age is that storage capacity, computing speed, and technology all grew to the point where large volumes of geographic and spatial information can be used for understanding business and other phenomena.

Spatial information covers all sorts of data (e.g., demographics, customer locations, real estate locations and values, and asset location). Sears, for example, uses spatial information to find the optimal routing for its 1,000 delivery trucks that cover 70% of the U.S. population. To use the system, they hand-coded millions of customers' addresses, put them in their data base, and then use the results to determine routes each day.

A spatial information system is more complex than a conventional back-office database system. In many respects, it is like a CAD/CAM system where data is kept on each of many layers, and the layers can be superimposed on one another as the user chooses. The spatial information system accesses spatial and attribute information, analyzes it, and produces outputs with mapping and visual displays. It needs to keep data on spatial boundaries and on attributes of the data. It includes tools and models to manipulate the data and boundary information. Furthermore, rather than just adding up columns of numbers, it requires understanding and using numerical algorithms, statistics, and operations research optimization and simulation techniques. In addition, spatial tools act on boundary layers, including union, overlay, buffering, nearest neighbor, and spatial attraction. You need much more expertise and capability to deal with spatial information systems data than with ordinary databases.

Despite the complexity, or perhaps because of its complexity, spatial information systems provide capabilities that offer competitive advantage. Of course, determining the extent of that advantage is a difficult task. Pick[3] points out that the up-front data costs tend to be much higher (more data needs to be acquired) and some costs, such as training needed for users with no experience, are difficult to estimate accurately. Furthermore, many more of the benefits are intangibles compared to conventional systems. For example, spatial information system applications tend to move up the value chain of a firm as they are used for planning or decision support (see Section III of this book). The value of the visualization aspects of spatial information systems is hard to quantify because we know little about how visual models improve decision-making.

An important recent example of a spatial information system is the global positioning systems (GPS) in your car. I have one, and it changes the way that I find my destination. Other new technologies associated with current spatial information systems include RFID, mobile wireless, and server software that deliver spatial information systems over the Internet. Enterprise applications, such as ORACLE, now provided GIS add-ons.

The book presents a sampling of what is going on in spatial information systems from a conceptual and application viewpoint. The book is divided into four sections:

I. Introduction
II. Challenges for Spatial Information Systems
III. Decision-Making Environments
IV. Future Trends and Technologies

Each of the sixteen chapters focus on a different application. Several themes do recur. One is the use of Web services for geospatial applications. In the past, all portions of a spatial information system resided in a single location. To undertake a new project often required adding software at that location. The new idea, which is gaining wide currency, is that the needed calculations can be subdivided into pieces,[4] each of which can be done by specialized programs, and that those programs may reside at a number of locations. Thus, data is sent to a vendor who provides the needed portion of the program, runs the calculation, and returns the computed values as inputs to the next subroutine or module.

The book brings together work by a large number of researchers looking at applying methods and techniques, including some that were developed for other purposes. You will find discussions of ontologies, directories, semantic Webs, agent theory, and robotics among others. In supporting decision-making, there are chapters on snow removal operations, determining suitable habitats for endangered species, and planning confined animal feeding operations. There are other intriguing applications such as:

- Using spatial information systems in teaching children content at the K-12 level by using a browser, without needing to teach them about the underlying system
- Identifying community-based resources, to provide a database of existing services, design the needed communications, identify missing resources, and other societal implications
- Visualizing the distribution of rare plants and other endangered species by using sensor networks that bring together DBMS, spatial information systems, and Web development technology

In short, the book leads you to start thinking about using spatial information systems in ways that almost none of us even conceived of only a few years ago. That is progress.

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Endnotes

[1] Tufte, E. (1983). *The visual display of quantitative information* (Chap. 2). Cheshire, CT: Graphics Press.

[2] Goode, H. H., & Machol, R. E. (1957). *Systems engineering*. New York: McGraw-Hill.

[3] Pick, J. B. (Ed.). (2005). *Geographic information systems in business* (p. 384). Hershey, PA: Idea Group Publishing.

[4] Sub-routines or modules in the old language of computing.

Paul Gray is professor emeritus and founding chair of the School of Information Systems and Technology at Claremont Graduate University, USA. Before coming to Claremont in 1983, he was a professor at Stanford University, Georgia Tech, USC, and Southern Methodist. Prior to that, he worked for 18 years in research and development organizations, including 9 years at SRI International. He is the author of three "first papers": in crime in transportation, in telecommuting, and in group decision support systems. He is the author of over 130 journal articles and 13 books, including *Manager's Guide to Making Decisions in Information Systems* (Wiley, 2006). His honors include the LEO award for lifetime achievement from AIS, a Fellow of both AIS and INFORMS, a winner of the NATO Systems Science Prize, and Outstanding Information Systems Educator of 2000. He was president of TIMS in 1992-1993. He is the founding editor of *Communications of AIS*, serving from 1999 to 2005.