BOOK REVIEW

Geographical Information Systems, Second Edition. Volume 1. Principles and Technical Issues and Volume 2. Management Issues and Applications

Edited by: Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind. (New York: John Wiley & Sons, Inc.), 1999. Volume 1 (pp 1—580), Volume 2 (pp 580—1101)

This two-volume set of *Geographical Information Systems* by Longley, Goodchild, Maguire, and Rhind is a "must have in the library" for both practitioners and academics. Its comprehensive contents include more than 1000 pages and 72 chapters, with close to 100 eminent contributors in the geographic information system (GIS) and related fields. The high quality of both the individual chapters and the overall text is then hardly surprising. The editors and the majority of authors are affiliated with North American and European academic, government, and private sector institutions, with a few authors from other continents – five from Australia and New Zealand, four from South Africa, and one from Asia. While this geographic distribution does not necessarily translate directly into the significance and nature of GIS activities, it suggests the regions dominating in GIS thought, invention, research, and practice.

With unlikely competition in the genre, *Geographical Information Systems* is justifiably called the "Big Book of GIS." The two volumes offer a state-of-the-art overview of the field and, similar to other disciplinary "big books,"* the new edition reflects the evolution of the field. Even those who have read the first edition will find a look at the second edition to be a worthwhile experience. In fact, in the making the second edition, the editorial team joined by Paul Longley started from scratch and the result is new organization and a new cast of authors. In the Introduction, the editors state that their intention, for example in presenting GIS history, is on "updating the story with a brief account of major events and trends since 1991 [when the first edition of this book appeared]" (p. 2) rather than on summarizing an already extensive publishing output. Other topics are also treated by building on existing knowledge and characterizing the recent developments and trends.

The contents of Volumes 1 and 2 in the two editions are displayed in the table below. Volume 1, "Principles and Technical Issues," dwells primarily on spatial data collection, development, and analysis. Following a theoretical introduction, a selection of topics addressed includes error and uncertainty in spatial data; spatial statistics and modeling; GIS interoperability; methods of data access; principles database design; spatial referencing; remote sensing and global of positioning systems as means of data capture; transformation of spatial data (e.g., interpolation); and virtual GIS. Volume 2, "Management Issues and Applications," discusses various aspects of GIS introduction into organizational settings and requirements for its effective use. Among other topics, the authors present institutional issues, legal implications, standardization, privacy concerns, and geospatial data policies. Examples of GIS applications are presented under the two categories of operational and social and environmental, the latter being a rather coarse grouping of quite diverse ways of employing GIS .

The main text of the book is complemented by 66 colored plates; the author and subject indexes are thorough and useful. The text also contains a 79 page consolidated bibliography. The contents, coherency, and overall organization of the two volumes are, to an extent, a reflection of the state of the discipli ne at the time the manuscripts were prepared. However, credit for improvements goes to the chapter contributors who, with many others,

First Edition	Volume 1	Section I: Overview	
		Section II: Principles	a. Nature of spatial data b. Digital representation c. Functional issues d. Display issues e. Operational issues
	Volume 2	Section III: Applications	a. National and international GIS programs b. Socioeconomic applications c. Environmental applications d. Management applications
		Section IV: Epilogue	
Second Edition	Volume 1	Part 1: Principles	a. Space and time in GIS b. Data quality c. Spatial analysis
		Part 2: Technical Issues	a. GIS architecture issues b. Spatial databases c. Technical aspects of GIS data collection d. Data transformation and linkage
	Volume 2	Part 3: Management Issues	a. Making the GIS efficient, effective, and safe to use b. Data as a management issue c. GIS as a management tool d. The impact of broad societal issues on GIS
		Part 4: Applications	a. Operational applications b. Social and environmental applications

participated in advancing the GIS field and to the editors who managed to capture those extensive developments and to provide a new framework for the field that flourished and began to mature during the 1990s. The opening sections of each volume, one on GIS principles and the other on management issues, illustrate this evolution of the field. The GIS principles are introduced with a general discussion of space and time in GIS, which draws on philosophy and history of science (geography, mathematics, and physics in particular); cognitive and social theory; and theoretical and methodological bases for representation, visualization, and substantial generalization of spatial data. This is a departure from a more pragmatic overview of GIS definitions and implementation settings (technological, commercial, government, and academic) that invited the readers of the first edition.

The management theme is an enhanced version of the "Operational Issues" section in the first edition. A somewhat awkward introduction to the theme reveals that management is still aside from the mainstream. The quality of individual contributions notwithstanding, this section could have more explicitly conveyed that GIS management is only one aspect of a more complex process of GIS technology transfer, organizational change, and general information resource management. In addition, the three sample applications of "GIS as a Management Tool" cover an interesting scope, ranging from business and service planning to public discourse and to state economy (Chapters 51—53), however, their grouping within Part 3 seems a bit contrived and somewhat arbitrary. With appreciation for different ways in which not only a section but a whole book could be organized, and despite the minor criticism, this section offers a wealth of information and insight.**

Common difficulties associated with compilations (such as ensuring systematic and complete coverage of relevant topics, repetition in contents, and flow and coherency of various book sections) are successfully mastered by the editors and only rarely experienced throughout the two volumes. As for the substantive critique, the editors themselves alert to the omissions from the first edition and the challenges of the second edition of the book. In some respects, the self-critique seems too harsh; for example, in not foreseeing the Internet-related developments and their implications on GIS software and future directions. The pace of technological change against the publication lag time makes it almost impossible to present it in a timely manner and quite difficult to envision the future. Even from 1999 when this book appeared (or 1997—1999, when it was most likely worked on), new technological solutions would make some of the text in the new edition out of date.

Otherwise, the editors' self-critique and commentary are insightful and thought provoking. For example, they accurately observe that, despite recognition in the early 1990s of the primary importance of GIS implementation and institutionalization challenges, there is a continued need for innovative technical solutions. Perhaps extending a bit on that comment or looking from a somewhat different perspective, this assertion of technical developments may contain an element of self-fulfilling prophecy

of the predominantly technical and system-oriented academic and professional community. Another perceptive remark is about invigorating information management and data-related aspects of GIS research and development as the key for wider adoption of GIS, opposed to an earlier call for enhanced analytical functionality. The return to data issues has indeed been strong. Perhaps less strong but equally important have been the efforts toward the other end of the data-system-function continuum. The efforts aim to extend the utility of GIS from data storage, manipulation, and presentation to decision-making tools. The only chapter that relates GIS to decision-support systems is Yeh's "Urban Planning and GIS" (Chapter 62). This topic, however, warrants more extensive treatment.

Finally, related to the introductory note about the regional affiliation of the contributors to the book, it should be noted that there is a lack of explicit presentation of international trends, issues, and policies. While many chapters, particularly the nontechnical ones, inevitably carry a specific regional perspective and are socioculturally embedded only one chapter in the book discusses national and international geospatial data policies. In the first edition a section "National and International GIS Programmes" contains six chapters with case examples from the United States (United States Geological Survey-USGS), United Kingdom (Ordinance Survey), Sweden, Japan, Australia, and developing nations. I applaud the editors for finding the wealth of theoretical and conceptual material accumulated in the 1990s more of a publishing priority and exciting content over descriptive case studies of GIS as used in particular countries or regions. However, an overview and equally conceptually rich presentation of the international arena and trends that go beyond European/Anglo-Saxon environment would be a valuable contribution to a future edition. The chapters on "National and International Data Standards" (Chapter 50), "National and International Geospatial Data Policies" (Chapter 56), "GIS in Land Administration" (Chapter 61), and a case study of South Africa (Chapter 65) partially fulfill this purpose.

The editors have upheld their promise to give the current awareness of the field and to look at the future. A figure "The changing domain of GIS" (p. 749) and a table "Factors supporting the GIS paradigm shift" (p. 1020) illustrate and summarize the editors' view of the evolving field of GIS. In the epilogue, they state the interaction between policies, institutional factors, technologies, applications, and social context as the guide for understanding and forging future endeavors. They review the areas and goals of research agendas in the US (the National Center for Geographic Information & Analysis-NCGIA and the University Consortium of Geographic Information Science-UCGIS) and Europe (GISDATA) to find considerable progress made toward more useful, integrated and networked but yet transparent GIS environments. From the public and private user sectors, they support the expectation for semantic and geometric integration; data encapsulation; intuitive, human cognition-based systems; standardization (de facto or other); developed and accessible spatial data infrastructures; geocomputation; GIS-based elementary education; and community empowerment. While GIS has moved away from "map metaphor" toward multimedia, virtual reality, and temporal GIS, and software and hardware inventions bring wonders of "wireless" and "wearable" computing, the editors expect "visible GIS" is here to stay.

I would highly recommend this unique book of encyclopedic proportion and value to our GIS community. The organization of the topics by Longley et al. makes the book's framework transparent and easy to grasp. Because the two volumes are not written in textbook style and because of an advanced level of treatment of topics (with some variation), I expect the contributions in the book be used as supplementary teaching materials to other books covering the GIS fundamentals. While those who closely follow the many streams of GIS literature have probably encountered some of the contributions in various other books or journals, it would be hard to find a comparable compilation of all the current significant material in one place. Many readers will encounter new and stimulating concepts, such as goecomputation, data mining, virtual GIS, semantics, interoperability, and ideas such as "encapsulation of data with methods" (driven by object-oriented environments). This is a shelf reference for every GIS developer, user, and researcher to be joined by third edition in due time.

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*Urban planning, for instance, had the third edition of its "Green Book" – The Practice of Local Government Planning — published in year 2000.

**The management theme can be used as an example of a tension characteristic for most of the GIS field. This tension arises from a somewhat awkward connection to other disciplines, to the broader system of knowledge, and to application contexts. While the GIS field draws on many traditional sciences (as explained by Couclelis in Chapter 2 "Space, Time, Geography"), its further developments are sometimes disjointed or even negligent of the source disciplines. Perhaps that is inevitable for an integrative field in the process of establishing its location and identity within the system of science and societal practice. The tension may be the manifestation of that struggle.