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Building a Foundation for Science: The GIS&T Body of Knowledge

Former National Science Foundation (NSF) Director Rita Colwell pointed out in "The New Landscape of Science: A Geographic Portal" (Colwell, 2004), that geography and its revolutionary new technologies are "well poised at this watershed juncture to help shape the new landscape of science." A landmark new reference book, the *Geographic Information Science and Technology Body of Knowledge*, marks an important step in that process. Published by the AAG in collaboration with the University Consortium for Geographic Information Science, the *GIS&T Body of Knowledge* is the first comprehensive approach to understanding the basic skills and knowledge relevant



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to the rapidly growing GIScience and technology (GIS&T) fields. This book and its subsequent editions will form a systematic foundation for education, research, and career development programs in the GIS&T fields for decades to come.

Geographic information science and technologies have today become critical components of the global science infrastructure, both in the university and in society. The integrative capabilities of these and related technologies have extended research frontiers across many fields, in areas ranging from ecology to medicine to transportation. Technologies such as geographic information systems (GIS) also have increasingly become the common ground for sharing data across disciplines, or the "glue" which connects large-scale interdisciplinary research, including much that is funded by NSF and other federal agencies.

The *Geographic Information Science & Technology Body of Knowledge* will have application and impact well beyond geography. To the extent that multi-disciplinary research and applications now depend on the integrative and analytical power of new geographic technologies, many disciplines within the academy are beginning to incorporate spatial concepts and perspectives into their curricula and research methodologies. The techni-

cal expertise and theoretical insights which have been developed over the recent decades within the GIS&T fields constitute a body of knowledge increasingly necessary to advancing research agendas throughout the university in programs ranging from statistics and biology, to engineering and law, and from sociology to computer science and history. GIS&T and related technologies are helping to catalyze new research, scholarship, and teaching within these fields, without diminishing or threatening the richness and diversity of traditional approaches within these disciplines.

An emerging GIS&T cyber-infrastructure also plays a central role in the larger society. A transformational feature on the GIS&T landscape, and a significant opportunity for our society, for example, will be the widespread continued development and implementation over the next several decades of real-time interactive geographic management systems (GMSs) as core daily operations management networks within most governmental and business organizations. Driven by real-time interactive GPS/GIS technology, these systems enable the continuous modeling and interactive management across space and time of the extensive fixed and mobile assets and workforces of complex real world operations, such as those of major electric utility companies, governmental emergency response agencies, national park agencies, modern military organizations, automated transportation and logistics systems, and international disaster and humanitarian relief operations. GMSs' dynamic space/time interactive core capabilities create a powerful platform for integrating many other technologies, including wireless communications, environmental sensors, work-order processing, remote sensing and imagery, software agents, econometric modeling and others, for both scientific research and societal applications (Richardson, 2001).

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The *GIS&T Body of Knowledge* will be an important reference and guide for these existing and future GIS&T infrastructures in science, in society, and in education. Significant credit for the development of the *GIS&T Body of Knowledge* goes to Duane Marble, who both advocated for and pioneered the development of the body of knowledge throughout the 1990s. Without Duane Marble's early efforts in this arena, this book would not exist. More recently, the work begun by Marble has been continued by many, including the UCGIS education committee, ably chaired by David DiBiase.

This first edition of the *GIS&T Body of Knowledge* is, as it must be, a work in progress. The AAG, as publisher, is committed to working with others to enhance, extend, refine, and continuously update this work in future editions. Subsequent editions will seek to extend the work to curricular implementations, to encompass new and rapidly evolving technologies in the GIS&T fields, and to broaden its focus as the science and technologies themselves become broader and more fully integrated.

The opportunities to diversify and build the GIS&T research and educational capacity within the academy, and in the larger societal workforce, are substantial. The US Department of Labor, for example, has designated geotechnology as "one of the three most important emerging and evolving fields, along with nanotechnology and biotechnology" (Gewin, 2004). Employment opportunities and workforce development needs are grow-

ing worldwide as our geographic technologies become integral to ever more areas of research and the economy.

This process of rapid scientific and technological transformation within GIS&T and in society raises public policy issues as well. As geographic data become more omnipresent, accurate, and locationally specific, issues of public accountability by organizations producing and using geographic technologies have arisen, including concerns about locational privacy, data confidentiality, and civil liberties. The *GIS&T Body of Knowledge* also acknowledges the importance of these issues in a section on GIS&T and society. Researchers and educators have a key role to play in the future implementation and management of the powerful capabilities of advanced geographic technologies, mediating the risk that is inherent in all technology for potential abuse, and assisting with the development of appropriate legal and regulatory frameworks governing their application. Social scientists engaged in critical analysis of GPS/GIS based geographic technologies—including consumer applications such as the increasingly widespread location-based services (LBS)—can contribute to shaping the future of geographic applications in government and commerce, and in helping to ensure a balance between the benefits and potential misuse of such technologies (Richardson and Solís, 2004).

Of course, neither processes of innovation nor patterns of technology adoption are spatially uniform. This uneven development

challenges educators and industry leaders to work together to develop meaningful, viable approaches to expand and diversify the GIS&T workforce. The *GIS&T Body of Knowledge* will serve as a useful guide during the creation of the specific educational and workplace pathways to achieve these goals. The publication also will be a key resource in the toolbox of GIS certification and accreditation bodies, job seekers, students, teachers, guidance counselors, curriculum planners, and GIS professionals in government, industry, and academia.

Finally, for those of us who have long been engaged in the research and development of the geographic information science and technology infrastructure, it is gratifying to see this effort to codify the results of this exciting and dynamic field of inquiry into a systematized body of knowledge that will support education and continued development of GIS&T in the future. I commend the editors for this important beginning, and look forward to working together with the entire GIS&T community to evolve and update this body of knowledge in the years ahead. ■

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¹ For additional information on the book and the references cited above, or to order copies of the *GIS&T Body of Knowledge* (\$20 each, plus \$5 shipping per order) see www.aag.org/bok. Editors are David DiBiase, Michael DeMers, Ann Johnson, Karen Kemp, Ann Taylor Luck, Brandon Plewe, and Elizabeth Wentz.