



Urban and Regional Information  
Systems Association

1460 Renaissance Dr., Suite 305 Park Ridge, IL 60068 (847) 824-6300

**Best Practices for Developing  
Geographic Information Models**

**URISA Certified Workshop**

# Best Practices for Developing Geographic Information Models

Dr. David K. Arctur, OGC Interoperability Institute  
Douglas M. Adams, Baltimore County

## URISA Certified Workshop

Even with decades of experience, effective design of a GIS database remains a combination of art and science. This workshop shows how you can build on your existing data and skills to take advantage of the latest generation of GIS tools and practices for database design. After an introduction to the fundamental concepts of GIS database design, we will present and discuss case studies of GIS databases designed for managing land parcels, inventorying municipal facilities for emergency preparedness, and automating a permit application. In the exercises, you will develop portions of conceptual, logical and physical data models. Through these case studies of successful and effective systems, you will gain a better understanding of the issues you can face, as well as the tools and processes you can apply, in developing many other kinds of systems.

### Revision History

V1.0	22 June 2000	URISA 2000
V2.0	13 Sep 2001	URISA 2001
V3.0	20 Sep 2002	URISA 2002
V4.0	20 Aug 2003	URISA 2003
V5.0	14 Oct 2004	URISA 2004
V5.1	28 Jan 2005	GeoTec 2005
V5.2	20 Sep 2005	URISA 2005
V5.3	19 May 2006	GeoTec 2006
V6.0	18 Aug 2006	URISA 2006
V6.1	14 Feb 2007	URISA 2007
V6.2	30 Apr 2007	URISA 2007

# Best Practices for Developing Geographic Information Models

## Course Outline

<b>1. Introduction .....</b>	<b>1-1</b>
How are we using GIS today?.....	1-4
GIS database design methodologies.....	1-10
Multi-tiered GIS database architectures.....	1-15
Data sharing and the Geospatial Web .....	1-19
Needed: standard approaches to data modeling .....	1-21
Course overview.....	1-24
<b>2. Database and object concepts.....</b>	<b>2-1</b>
Files, databases, and GIS.....	2-3
Water Use Permit example.....	2-8
Normalization and table relationships.....	2-11
Database diagramming.....	2-22
Concepts and UML notation: Object classes & instances, attributes, methods, and relationships .....	2-25
Comparing relational database and object-oriented terms .....	2-32
Recap of basics.....	2-34
References .....	2-36
<b>3. GIS database design process .....</b>	<b>3-1</b>
Design process.....	3-4
Cost-benefit analysis .....	3-10
Use cases .....	3-14
Designing GIS databases.....	3-22
Conceptual design .....	3-24
Exercise: Hurricane Emergency Response conceptual design.....	3-30
Logical design .....	3-34
Physical design.....	3-40
Exercise: Water Use Permit Automation .....	3-46
FGDC Address Data Standard .....	3-63
Prototype, Pilot, and Production systems.....	3-64
GIS&T Body of Knowledge .....	3-72
References .....	3-73

# Best Practices for Developing Geographic Information Models

## Course Outline

<b>4. Facilities data model example .....</b>	<b>4-1</b>
Introduction to Baltimore County’s facilities data model .....	4-2
Building on existing address data model.....	4-6
Aerial photo examples of multi-addresses and use codes .....	4-7
NAICS and HSIP use codes .....	4-12
Developing the conceptual data model .....	4-14
Further design considerations, maintaining feature metadata .....	4-21
Exercise: developing the logical model .....	4-24
Resources .....	4-35
<b>5. Parcel data model example.....</b>	<b>5-1</b>
Demonstration and overview of parcel model template.....	5-2
Introduction to Baltimore County’s parcel data model .....	5-5
Learning curve for FGDC standard and Arc Parcel data model .....	5-9
Project requirements and design .....	5-11
Demonstration of Baltimore County parcel data model.....	5-13
Adapting the parcel data model template to suit .....	5-14
Integrating existing data into the data model template .....	5-22
Topology rules.....	5-23
Lessons learned .....	5-28
Resources .....	5-30
<b>6. Getting there from here .....</b>	<b>6-1</b>
What have we learned? .....	6-2
Why does this matter? .....	6-4
The key is collaboration .....	6-5
Training and mentoring.....	6-7

## About the Instructors

**Dr. David K. Arctur** is President and Chief Technology Officer of the OGC Interoperability Institute, Inc., a non-profit organization stimulating and coordinating involvement by the academic research community to solve difficult problems in geospatial systems interoperability. From 2000 till July 2006, Dr. Arctur was a data architect, interoperability engineer, and technical writer for the Environmental Systems Research Institute (ESRI). He represented ESRI in the Open Geospatial Consortium (OGC) standards organization and co-chaired three of the working groups. He is coauthor of the book, *Designing Geodatabases: Case Studies in GIS Data Modeling* (ESRI Press, 2004). Prior to joining ESRI, he was Chief Scientist at Laser-Scan Inc, a GIS software company in Sterling Virginia (1996-99). In this role he initiated and directed several development projects for the U.S. National Imagery and Mapping Agency and the U.S. Geological Survey. These projects included the design and development of object-oriented map production systems and web-based map distribution systems; design of an object-oriented geospatial data transfer format based on XML; and research in automated map conflation techniques. Prior to entering the GIS field, he taught relational database design and object-oriented programming for 8 years at Informix and ParcPlace Systems in Silicon Valley, and was involved in electric power industry research for 5 years at the Electric Power Research Institute and the Stanford Research Institute. He received his BS and MS in Electrical Engineering at the University of Texas at Austin, and his Ph.D. in Urban and Regional Planning at the University of Florida.

Dr. Arctur has over 18 years of programming experience, including more than 6 years in object-oriented programming and 10 years in database application design and development, and has been involved in GIS software development for over 10 years. He has developed and conducted numerous seminars in object-oriented GIS technology for industry conferences since 1996. He is a member of ACM, IEEE and URISA.

Email: [darctur@ogcii.org](mailto:darctur@ogcii.org)

**Douglas M. Adams** is a Business Analyst in the Office of Information Technology for Baltimore County, Maryland, where he is responsible for the county's enterprise GIS operation and maintenance. His unit is responsible for maintenance of six enterprise databases: planimetric/topographic, orthophotography, street centerline, cadastral, facilities, and census blocks. Additionally, he is responsible for applications development and maintenance for the county's land management agencies. He received his BS and MA in Geography and Environmental Planning at Towson University. Prior to joining Baltimore County, he was the GIS Manager at Johnson, Mirmiran and Thompson. At JMT, he reinvigorated the firm's GIS Office and integrated GIS into the engineering firm's existing capabilities. As GIS Manager for Harford County, Maryland, Mr. Adams implemented the county's enterprise-wide GIS. He has also worked for the Naval Technical Intelligence Center as an Intelligence Photogrammetrist, and for the National Geospatial-Intelligence Agency (formerly Defense Mapping Agency) as a cartographer developing nautical products.

Mr. Adams has over 20 years of cartographic and geographic information systems experience. He served as a local government representative on the Geospatial One-Stop Standards Harmonization efforts. Mr. Adams is working on the FGDC Homeland Security Working Group for Symbology to develop a standard set of symbols for use by the Emergency Management and First Responder communities at all levels of need. He is an active member of MSGIC – Maryland State Geographic Information Committee and is working to design, develop and deploy state-wide database and compilation standards. Mr. Adams is an adjunct faculty at Towson University and the University of Maryland Baltimore County, where he teaches Interpretation of Aerial Photography, and GIS Database and System Design, respectively.

Email: [dadams@co.ba.md.us](mailto:dadams@co.ba.md.us)