GIS for Federal Buildings:
BISDM Version 2

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PAPER SESSIONS

Managing Federal Real Property
Thursday, February 18 – 8:30-10:00 – Room 143C
Users from four different Federal agencies will explain some of their recent work in applying GIS to improve the management of their real property assets. Applications include supporting multiple sites, integrating with ArcGIS Web services and Google Earth, decision support solutions, and a facility data fusion solution.

Managing Real Property – Civilian Agency Applications
Thursday, February 18 – 10:30-12:00 – Room 143C
Users from various Federal civilian agencies will share their experiences in spatially enabling real property management applications. Examples will include a spatially enabled decision support solution, an application to optimize your interior space utilization, plus asset management and project management solutions.

Managing Real Property – Defense Agency Applications
Thursday, February 18 – 2:00-3:30 – Room 143C
Assets and services at Defense installations support numerous military missions and need to be managed in a cost-effective, safe, sustainable, and environmentally sound manner. In this session, you will hear from representatives of the Pentagon, Marine Corps, Navy, and Air Force on ways to improve the management of these vital assets.

Technical Workshops

GIS for Federal Buildings: BISDM Data Model Version 2
Thursday, February 18 – 4:00-5:30 – Room 156
This workshop will present recent revisions to the Building Interior Space Data Model (BISDM) version 2 template. The BISDM template has been successfully used and adapted in a number of real-world projects to meet a variety of enterprise integration and business application requirements in the past year.

GIS for Federal Buildings: 3D GIS for Facilities
Friday, February 19 – 8:30-10:00 – Room 156
New 3D GIS capabilities in ArcGIS provide facility managers with a set of tools to manage and assess existing facilities, as well as evaluate planned facilities. Attendees will be introduced to the different 3D display platforms and various spatial analysis tools.

GIS for Federal Buildings: Data Input, Editing and Management
Friday, February 19 – 10:30-12:00 – Room 156
As facilities managers consider implementing an enterprise solution, the most common issues are managing disparate data. How do I bring my paper drawings, spreadsheets, GIS, and CAD data into a common database to serve as the platform for an enterprise facilities management solution? This workshop will discuss the process, workflows, data models, and tools required to input, edit, and manage an enterprise facilities management database.

User Group Meeting
SIG – Buildings & Facilities Data Theme
Friday, February 19
2:30-4:00
Room 156
Topics

• Quick History of BISDM effort

• Layout of BISDM Version 2 and Supporting Resources

• Core Object Model and Attribute Enhancements

• New Support for Assets and BIM-GIS integration PTC’s

• BISDM Version 3 Highlights *(Late Summer 2010)*
  – support for 3D objects and transportation networks
Quick History of BISDM Effort
GIS Is Core Technology
It is used to build Information Systems
Supporting Many Professions, Workflows and Application Domains

Information Systems for
- Natural Resources
- Land Use Planning
- Transportation
- Land Management
- Business Analysis
- Geospatial Intelligence
- Defense
- Visualization
- Scientific Analysis
- Public Safety
- Demographics
- Health Care
- Cartography
- Asset Management
Total Scalability Using GIS

World
  - Country
    - Region
      - State / Province
        - County
          - City

Site
  - Natural Asset
    - Air / Space
      - Underground
    - Water / Sea
  - Real Property Asset
    - Land / Parcel
  - Facility / Built

Building
  - System
    - Space
      - Overlay
      - Level
    - Sub-Systems
      - Components
    - Room
  - Structure
    - System
      - Space
        - Overlay
        - Level
      - Sub-Systems
        - Components
    - Room
    - Node
      - Segment

Traditional GIS Space

Traditional CAD/BIM Space
Manage, Analyze, and Report building data at all scales

Building Attributes:
- Owner / Occupant
- Form / Function
- Deferred Maintenance
- Value (FRV) / Charge back
- Asset Condition (CI)
- Utilization / Predominant Use
- Sustainability / LEED

Building Systems:
- Fiber / Telecom
- Power / Water / HVAC
- Emergency / Security
- Environmental / Energy Star
- Alternative Energy

Global → Country → Region → City → Campus → Building → Rooms, Equipment, Furniture
ESRI Geodatabase Data Models

Standardized Templates for Many Fields

- Address
- Agricultural
- Atmospheric
- Base Map
- Biodiversity
- Carbon Footprint
- Census-Admin
- Boundaries
- Defense-Intel
- Energy Utilities
- Environmental
- Forestry
- Geology
- Groundwater
- Health
- Historic Preservation & Archaeology
- Homeland Security
- Hydro
- IHO
- Land Parcels
- Local Government
- Marine
- National Cadastre
- Petroleum
- Pipeline
- Telecommunications
- Transportation
- Water Utilities
- Building Interior Space
ESRI’s Building Interior Space Data Model (BISDM) for GIS

An user community effort

- Started in summer 2007
- Build template to serve many uses cases and compatible technologies
- Real-world project tested
- Support property, building, and asset objects
- Models, supporting documentation, data loading tools, and sample viewers at www.esri.com/datamodels
Geodatabases support Real Property Industry Specifications

• Defining and measuring building space
  – BOMA and FICM

• Classifying building space -- form, function, assets
  – Open Standards Consortium for Real Estate (OSCRE)
  – OmniClass™

• Building information models (BIM)
  – NBIMS a buildSMART initiative
  – Industry Foundation Classes (IFC)

• Building object information exchange
  – Construction Operations Building Information Exchange (COBIE) a buildSMART initiative
Split and Merged BISDM’s

- **Merged**
  - GIS only

- **Split**
  - GIS + BIM/EAM/IWMS
ESRI Geodatabase Data Models

• Go to www.esri.com/datamodels
Layout of BISDM Version 2 and Supporting Resources
Core Object Model
and Attribute Enhancements
Facilities GIS Serves Many Masters

Public Safety
- Security
- Emergency Response

Real Estate
- Facilities Maint.
- Space Planning

Health & Environment

Real Property
BISDM is designed to be adapted to many purposes
Figure 3. Data Model Hierarchical Structure Diagram
BISDM 2.0

Region

Building

Floor

Floor Section

Floorplan Line

Space

Asset

Georaster

Photo

Photo Location
### Floor

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
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<tr>
<td>FLOORID</td>
<td>The unique identifier for the floor.</td>
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<tr>
<td>BUILDINGID</td>
<td>Used to identify the building in which this floor is found.</td>
</tr>
<tr>
<td>SHORTNAME</td>
<td>The floor number if there is one (e.g. 1, 1B, 2), otherwise null.</td>
</tr>
<tr>
<td>VERTICALORDER</td>
<td>Used to reliably sort the floors by vertical order as base elevation is not always known.</td>
</tr>
<tr>
<td>BASEELEVATIONM</td>
<td>The base elevation of the floor in meters.</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>A short description of the floor (e.g. 'Basement').</td>
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<tr>
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<td>The last date when this record was updated.</td>
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<tr>
<td>LASTEDITOR</td>
<td>The user name of the person that made the last update.</td>
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### FloorSection

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<td>Used to identify the floor to which the floor section belongs.</td>
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<tr>
<td>SHORTNAME</td>
<td>The name of the floor section (e.g. 'East Wing').</td>
</tr>
<tr>
<td>SECTIONTYPE</td>
<td>Type of floor section</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>A short description for the floor section.</td>
</tr>
<tr>
<td>HIGHVERTORD</td>
<td>High vertical order for a path that spans multiple floors.</td>
</tr>
<tr>
<td>LOWVERTORD</td>
<td>Low vertical order for a path that spans multiple floors.</td>
</tr>
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<td>The last date when this record was updated.</td>
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<td>The user name of the person that made the last update.</td>
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</tbody>
</table>
**Represent an interior space such as hallways, rooms, and stairwells.**

- **SPACEID:** The unique identifier for the space.
- **FLOORID:** Used to identify the floor in which this space is found.
- **SECTIONID:** Used to identify the floor section (e.g. wing, zone) in which the space is found.
- **SHORTNAME:** The space name/number if there is one, otherwise null.
- **DESCRIPTION:** A short description for the space.
- **SPACETYPE:** Used to identify the space type if there is one, otherwise null.
- **LONGNAME:** The space name if there is one, otherwise null.
- **MEASUREMENTSTD:** The measurement standard to which the space boundaries are drawn (e.g. BOMA, FICM, etc). If null, no measurement standard can be assumed.
- **SPACECATEGORY:** Used to identify the space category if there is one, otherwise null.
- **BASEELEVATION:** The base elevation of the space if known, otherwise null.
- **CEILINGHEIGHT:** The most common ceiling height for the space if known, otherwise null.
- **CEILINGMATERIAL:** Used to identify the ceiling material for the space if known, otherwise null.
- **FLOORMATERIAL:** Used to identify the floor material for the space if known, otherwise null.
- **DEPARTMENT:** The department to which this space belongs (e.g. 'Engineering').
- **DIVISION:** Company Division
- **NOTES:** Used to store additional notes about the space.
- **ACCESSTYPE:** Used to identify the access type for the space (e.g. private, public).
- **CAPACITY:** The total number of occupants allowed in this space.
- **OCCUPANCY:** The total number of occupants assigned to this space.
- **REPPAREA:** The reported area of the space in meters.
- **REPPERIMETER:** The reported perimeter of this space.
- **REPPWINDOWAREA:** The reported window area for this space in meters.
- **STATUS:** The status of the space (e.g. Closed for repair).
- **ORGANIZATION:** Used to identify the organization assigned to the space.
- **LASTUPDATE:** The last date when this record was updated.
- **LASTEDITOR:** The user name of the person that made the last update.
BISDM 2.0
BISDM 2.0
New Support for Assets and BIM IFC’s
BIM Provides Benefits for Design and Construction

- Improved design process
- 3-D visualization for owner
- Coordination between disciplines
- Interference checking
- Facilitates energy efficiency and LEED
- Automated quantity take offs
- 4-D scheduling
- Improved documentation of design intent
- Potentially used for fabrication
BIM is Not being used for Lifecycle Asset Management

Optimized approach with virtual modeling and analysis with reduced change orders & delivery time and lower operating and sustainment costs

Typical approach failing to do routine maintenance and having to replace items earlier and more often

Typical design/build approach with required maintenance

The savings we are currently experiencing with faster delivery and fewer change orders

The yet untapped Savings

Dollars Expended on Facility

Utilization Stage

Closure Stage

Conception Stage

Project Delivery Selection Stage

Design Stage

Construction Documents Stage

Execution Stage

Procurement Stage

Utilization Stage

Closure Stage

2yr

100+ Years

1Yr

Courtesy of DKS Information Consulting, LLC
Should We Use BIM As a Spatial Data Repository?

- File-based
- Proprietary data formats
  - Exports to IFC not uniform
- Not easily query-able across multiple facilities
- Not scalable to large number of users
  - BIM Server technology limited to design focus
- Limited security
- No clustering, failover, etc.

Not a Viable Solution – The Spatial Repository Should be GIS
Elements in BIM are Created at a High Level of Detail

This data is required to convey the information needed to construct the facility.

All BIM products export BIM data to and Industry Foundation Classes (IFCs)
BIM to GIS Integration Issues

• BIM is MUCH richer in detail than a GIS database should be
• BIM contains all the information needed to construct a building, but not to manage it
  – Space polygons
  – Occupant information
  – Asset details (make, model, etc.)
  – Equipment maintenance data
• The missing data is supplied by COBie
Construction Operations Building Information Exchange (COBie) adds Tabular Information to BIM

- Capture tabular data needed by the owner as it is created by
  - Designers
  - Constructors
  - Commissioning Agents
- Industry participation
  - BIM vendors now export to COBIE
  - CMMS/CAFM vendors import COBIE
- Some of the COBie data belongs in GIS
- GIS Asset tables need to store a sufficient level of detail
BISDM Asset Data Feature Classes

**Proposed Assets Class Names:**
- ConveyanceArea (polygon)
- ConveyanceFlow (line, geometric network)
- ConveyanceJunction (point, geometric network)
- ElectricalEquipment (point)
- ElectricalConductor (line)
- ElectricalArea (polygon)
- FireProtectionEquipment (point)
- FireProtectionConduit (line)
- FireProtectionArea (polygon)
- HVACEquipment (point)
- HVACConduit (line)
- HVACArea (polygon)
- PlumbingFixture (point)
- PlumbingConduit (line)
- PlumbingArea (polygon)
- StructuralFixture (point)
- StructuralMember (line)
- StructuralArea (polygon)

Mimics the structure of IFCs
Conveyance Feature Classes

- BuildingHasConveyanceArea
  - assetID
  - assetAlias
  - buildingID
  - description
  - capacity
  - conveyanceUse
  - conveyanceType
  - doorQuantity
  - adaCompliant
  - floorsServed
  - keyAccessFloors

- ConveyanceArea
  - PK: Unique identifier for the conveyance asset. PK to a CMMS.
  - Common name for the conveyance area (e.g., NW Stairwell, Main Lobby Escalator).
  - The building ID of the building in which the area resides.
  - Description of the area.
  - Load capacity of the system (e.g., lbs of passengers or freight).
  - How the conveyance system is used (e.g., Passenger, Freight).
  - The type of conveyance system (e.g., Elevator, Escalator, Stairwell).
  - Number of doors to which the area can be entered/entered.
  - Is the conveyance system ADA Compliant?
  - Yes/No.: Yes/No.

- ConveyancePath
  - PK: Unique identifier for the conveyance object. PK to a CMMS.
  - Common name for the conveyance object (e.g., NW Stairwell, Main Lobby Escalator).
  - The building ID of the building in which the area resides.
  - Description of the path.
  - Maximum Flow Volume through this path (e.g., persons/minute; tons/hour).
  - Is the conveyance system ADA Compliant?
  - Yes/No.: Yes/No.

- ConveyanceType
  - Code: Elevator, Escalator, Stairwell, MovingWalkway.

- EmergencyType
  - Code: None, Fire, Tomato, Earthquake, Hurricane, FlashFlood.
  - Type of Emergency: None, Fire, Tomato, Earthquake, Hurricane, FlashFlood.
Electrical Feature Classes (Typical of Others)
Two Scenarios for Managing Asset Data in GIS

• Limited asset detail available
  – No BIM
• Attributes maintained in GIS
• Simple data model

• BIM detail available
• Too much data to be maintained entirely within GIS
• BIM data stored in external database
  – RDBMS
  – BIM Server
  – CMMS (COBie data)
• Split data model
“Split” Data Model to Interface with External Database (or Future BIM Server)

ConveyanceArea
- (PK/FK) ASSETID (guid)
- ALIAS
- (FK) ENTITYID (guid)
- DESCRIPTION
- CAPACITY
- CONVEYANCEUSE
- CONVEYANCETYPE
- DOORQTY
- ADCOMPLIANT
- FLOORSSERVED
- KEYACCESSFLOORS

vElevator
INNER JOIN ON ConveyanceArea.AssetID = Elevator.ELEVATORID
- (PK) ELEVATORID (guid)
- REFERENCE
- FIREEXIT
- CLEARWIDTH
- CLEARDEPTH
- CLEARHEIGHT

vEscalator
INNER JOIN ON ConveyanceArea.AssetID = Escalator.ESCALATORID
- (PK) ESCALATORID (guid)

vStairWell
INNER JOIN ON ConveyanceArea.AssetID = Stairwell.STAIRWELLID
- (PK) STAIRWELLID
- REFERENCE
- NUMOFFRISER
- NUMOFTREADS
- RISERHEIGHT
- TREADLENGTH
- NOSINGLENGTH
- WALKINGLINEOFFSET
- TREADLENGTHATOFFSET
- TREADLENGTHATINNERSIDE
- HEADROOM
- WAISTTHICKNESS

vMovingWalkway
INNER JOIN ON ConveyanceArea.AssetID = MovingWalkway.MOVINGWALKWAYID
- (PK) MOVINGWALKWAYID

1

“Is A Type Of” Relationship

BIM Data
Asset Feature Classes in GIS
Interior Features In Table of Contents
BISDM Version 3 Highlights
3D Transportation Networks

*Interior networks, integrated with exterior networks*

- Can represent different modes of transportation
  - Hallways, stairs, escalators, elevators
- The ability to do route tracing
  - Ability to insert blocks in the network
  - Ability to block certain directions
- The ability to do transportation analysis
  - Nearest Facility
  - Travel distance and time analysis
  - Location/allocation
- Supported by new functionality available in 10
  - New Geometric support for vertical lines, including 3D length
  - New network solvers that produce 3D results
3D Transportation Networks

**Basic Components**

### Simple feature class

**FloorLines**

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<th>Default value</th>
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**Subtypes of FloorLines**

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### Simple feature class

**FloorTransitions**

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**Subtypes of FloorTransitions**

**Default subtype** G

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<td>2</td>
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3D Transportation Networks
Modifiers to network behavior, and core objects

Simple feature class
DelayTurns

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Simple feature class
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### 3D Transportation Networks

*Components used in specific network solvers*

#### Simple feature class: OfficeCenters

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#### Subtypes of OfficeCenters

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#### List of defined default values and domains for subtypes in this class

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#### Simple feature class: Electrical Panels

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#### Simple feature class: FireHydrants

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#### Simple feature class: Vending Machines

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3D Transportation Networks

Interior networks, integrated with exterior networks

Basic components of the network

The basic network of hallways inside a building, as a collection of simple lines (no curves), with a separate subtype for each floor to aid in editing.

Modifiers to network behavior

Indicates delays on the network, for example wait times at elevators.

Components created/required by Network Analyst

Junctions generated by network analysts for purpose of processing.

Components used in specific network solvers

This is an example of a feature you might want to route people to and from. However, it could be any point feature such as assets.

Subtypes of OfficeCenters

A list of defined default values and domains for subtypes in this class

Subtypes of FloorTransitions

A list of defined default values and domains for subtypes in this class

Subtypes of FloorLines

A list of defined default values and domains for subtypes in this class

Subtypes of OfficeCenters

A list of defined default values and domains for subtypes in this class

Modifiers to network behavior

Indicates delays on the network, for example wait times at elevators.

Components created/required by Network Analyst

Junctions generated by network analysts for purpose of processing.

Components used in specific network solvers

This is an example of a feature you might want to route people to and from. However, it could be any point feature such as assets.
3D Transportation Networks

3D Network Analysis – Nearest Facility

ArcGIS 10 - PreRelease
3D Transportation Networks

3D Network Analysis – Network Reach

ArcGIS 10 - PreRelease
3D Transportation Networks

3D Network Analysis - Allocation

ArcGIS 10 - PreRelease
3D Transportation Networks

Schedule and next steps

- Will be available with the next release of the BISDM model
  - Expected in the late Summer of 2010
- Dependant of the capabilities of ArcGIS 10
  - Requires Network Analyst
  - Does NOT require 3D Analyst
- Demonstration dataset will be available

- Next steps
  - Expansion of the network model to support 3D utilities
    - Starting with electrical and telecom
    - Followed with gas, water, waste-water
  - Currently possible by the creation of custom solvers
  - Generic “out of box” solution in development

For more information, go to www.bisdm.org
Expanding the core model from 2D to 3D

Method of representation, and creation

• Changes to methods of storing Z values
  – Storing Zs as part of the geometry
  – Only necessary for points, lines, and polygons

• Changes to geometric method of representation
  – Conversion of
    • Polygons to a multipatch volumes
    • Lines to a multipatch surfaces
  – Editing multipatches to create more complex volumes
  – Generating multipatches from lidar point clouds
Expanding the core model from 2D to 3D

Changes to methods of storing Z values

• Can be done by
  – Creating a new feature class, Z enabled, based on old scheme
  – Loading old data into new feature class
  – Set z values based on an attribute via code

• Disadvantages
  – Harder to update elevations
  – Harder to select features by elevation
    • Can be mitigated by storing as attribute as well
  – Not as easy to do for features that have multiple Zs

• Advantages
  – Can use Feature Classes directly in geoprocessing
  – Consistent behavior between feature classes
  – Supports 3D Editing
Expanding the core model from 2D to 3D

Changes to methods of storing Z values
Expanding the core model from 2D to 3D

Changes to methods of storing Z values
Expanding the core model from 2D to 3D

Changes to methods of storing Z values
Expanding the core model from 2D to 3D

Changes to geometric method of representation

- Changes to geometric method of representation
  - Conversion of
    - Polygons to a multipatch volumes
    - Lines to a multipatch surfaces
  - Editing multipatches to create more complex volumes
  - Generating multipatches from lidar point clouds
Expanding the core model from 2D to 3D

Changes to geometric method of representation

• Can be done by
  – Extruding a space layer by room height
  – Use Layer 3D to Feature Class to convert them to Multipatches
  – If edits are required
    • Export the multipatch to a Collada model
    • Edit the model in SketchUp, or another detailed 3D editing program
    • Replace the original multipatch using 3D Editing

• Disadvantages
  – Harder to edit

• Advantages
  – Can be used to calculate room volumes
  – Can be used in 3D Set Operator Analysis
Questions / Feedback