Building Information Modeling—Agency Wide Actions

The United States General Services Administration

Public Buildings Service

Office of the Chief Architect

National 3D-4D-BIM Program
Sample GSA Projects
PBS Inventory

Buildings ~8,700
Owned ~1,600 180 million sq.ft.
Leased ~7,100 159 million sq.ft.

GSA presence in 2,100 communities
Federal workers housed in GSA space exceed 1.1 million
GSA’s Project Portfolio
– 193 Active Major Projects, $12.4 Billion

<table>
<thead>
<tr>
<th>Program Type</th>
<th>Number of Projects</th>
<th>RSF</th>
<th>ETPC (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospectus</td>
<td></td>
<td></td>
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<tr>
<td>Lease</td>
<td>23</td>
<td>4,466,028</td>
<td>$1,094,088</td>
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<tr>
<td>New</td>
<td>70</td>
<td>14,643,969</td>
<td>$6,355,564</td>
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<tr>
<td>R&amp;A</td>
<td>100</td>
<td>33,683,912</td>
<td>$4,920,444</td>
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<tr>
<td>Non Prospectus</td>
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</tr>
<tr>
<td>Minor New</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor R&amp;A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hist Preserv</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reimbursable</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Totals</td>
<td>193</td>
<td>52,793,909</td>
<td>$12,370,096</td>
</tr>
</tbody>
</table>
PBS 3D-4D-BIM Program

GSA Office of the Chief Architect (OCA)

provides national leadership, coordination, and guidance to all GSA regions on design, construction, art, urban development, security, accessibility, sustainability, and Building Information Modeling (BIM).
GSA’s National 3D-4D-BIM Program

From introduction,
  to pilots and technology/standard development,
  to policy and budget and guidance,
  to program and project deployment and supports

- 10 OCA-led pilots completed
- 10+ OCA-led pilots underway
- 25+ OCA supports on ongoing GSA projects
Why BIM matters to GSA?
PBS 3D-4D-BIM Program

10 Pilot Projects led by the OCA:

Across different regions, project types, phases:

Region 2   26 Federal Plaza, NY
Region 7   FBI Field Office Building, Houston, TX
           El Paso Courthouse, TX
           Las Cruces Courthouse, TX
Region 9   300 North Los Angeles Street, CA
Region 10  Pioneer Courthouse, OR
Region 11  Eisenhower Executive Office Bldg, DC
           GSA Regional Office Building, DC
OCA       Proof-of-Concept
           Northern Border Station Prototype
Initiated by GSA Offices and Regions

**Portfolio [NCR]:**
St. Elizabeth (laser scanning) Optira

**Property Development [NCR]:**
St. Elizabeth (site model) AEC InfoSystems

**Office of Applied Science + CIO Venture Capital Pilot:**
Jackson Courthouse H3

**Property Management [Region 9] + DOE funding:**
Santa Rosa Federal Building LBNL
San Diego Courthouse LBNL, UCSD

**Property Management [Region 6]:**
As-Built Documentation of 4 Facilities
Legend:

- 3D/4D/BIM authors or integrators of virtual models
- CM benefactors of virtual models
- GC/DB
- GSA
- A/B
- Client Agency
### Initiated by A/E:

#### A/E-Consultants:

<table>
<thead>
<tr>
<th>Department of Commerce</th>
<th>GGA/EEK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle Courthouse</td>
<td>NBBJ</td>
</tr>
<tr>
<td>Eugene Courthouse</td>
<td>Morphosis</td>
</tr>
<tr>
<td>San Francisco Federal Building</td>
<td>Morphosis</td>
</tr>
<tr>
<td>El Paso Courthouse</td>
<td>BPLW</td>
</tr>
<tr>
<td>Las Cruces Courthouse</td>
<td>ASCG</td>
</tr>
<tr>
<td>Cape Girardeau Courthouse</td>
<td>F. Bradburn</td>
</tr>
<tr>
<td>Ft. Pierce Courthouse</td>
<td>PGAL</td>
</tr>
<tr>
<td>FOB 8 (MEP)</td>
<td>GHT</td>
</tr>
<tr>
<td>Kansas City IRS</td>
<td>tbd</td>
</tr>
<tr>
<td>La Fayette (Proposed)</td>
<td>DMJM</td>
</tr>
<tr>
<td>FDA</td>
<td>RTKL</td>
</tr>
</tbody>
</table>

and more...
Legend:  
- authors or integrators of virtual models  
- benefactors of virtual models
Initiated by CM and GC:

**Ongoing:**
- Richmond Courthouse: Jacobs
- Fallon Federal Building: Jacobs

**Proposed:**
- Census Headquarters: Hensel Phelps (bidder)
- 1800 F Street: Heery
- Court of International Trade: Parsons Brinckerhoff
- U.S. Mission to UN: Jacobs

And by Holder, Turner, Clark, Mortenson, etc.
### Pre-Design
- As-Built Documentation
- Program development/Feasibility

### Concept Design
- Validate: program, circulation, egress, energy, urban, preservation, cost

### Design Development / Const. Doc
- Production, coordination
- Mockup
- Phasing

### Construction
- collision detection
- construction sequencing
- shop drawing, fabrication
- construction tolerance

### Commissioning / Operation
- as-built documentation
- system conditioning and reporting
- spatial data management
Pre-Design
- As-Built Documentation
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PBS 3D-4D-BIM Program

Historic: 26%
Mid-Century: 56%
Design Excellence: 7-8%
Technology Solution: 3D Laser Scanning and Penetrating Radar Technologies

Analogy of X-Ray and MRI in medicine

- physicians don’t perform operations based on medical history alone
- most up-to-date condition
- local or comprehensive
St. Elizabeth’s Campus [NCR Portfolio]
St. Elizabeth’s Campus [NCR Portfolio]
St. Elizabeth’s Campus [NCR Portfolio]
PBS 3D-4D-BIM Program

St. Elizabeth’s Campus [NCR Portfolio]
PBS 3D-4D-BIM Program

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PBS 3D-4D-BIM Program

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### Business Question:

How does PBS validate whether the design meets our program during concept phase?

<table>
<thead>
<tr>
<th>Space Measurement</th>
<th>Efficiency</th>
<th>Portfolio/Property Management</th>
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</thead>
<tbody>
<tr>
<td>Gross Building Area</td>
<td>Volume</td>
<td>STAR space type</td>
</tr>
<tr>
<td>Gross Design Area</td>
<td>Public/Private Ratio</td>
<td>STAR space category</td>
</tr>
<tr>
<td>Usable Area</td>
<td>Fenestration Ratio</td>
<td>Agency Bureau Code</td>
</tr>
<tr>
<td>Rentable Area</td>
<td>Skin to Floor Ratio</td>
<td></td>
</tr>
</tbody>
</table>
PBS OCA 3D-4D-BIM Program

- A/E tabular reports and verbal responses
- 2D tracing of spaces to perform “polyline” area summation
- management of alterations over a building’s life-cycle

In the new El Paso Courthouse project, BPLW has chosen (by their discretion) to build a 3D BIM to support its construction documentation. We thank BPLW for sharing its BIM. We have conducted a review of the model and offered the following observations.
Basis for Spatial Program Validation

*During Early Project Phases*

- Region’s SDM Formatting Standard

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**STANDARD METHOD FOR MEASURING FLOOR AREA IN OFFICE BUILDINGS**

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**DEFINITIONS**

**BUILDING COMMON AREA** shall mean the areas of the building that provide services to building tenants but which are not included in the OFFICE AREA or STORE AREA of any specific tenant. These areas may include, but shall not be limited to, main and auxiliary lobbies, atrium spaces at the level of the finished floor, concierge areas or security desks, conference rooms, lounges or vending areas, food service facilities, health or fitness centers, daycare facilities, locker or shower facilities, mail rooms, fire control rooms, fully enclosed courtyards outside the exterior walls, and building core and service areas such as fully enclosed mechanical or equipment rooms. Specifically excluded from **BUILDING COMMON AREA** are **FLOOR COMMON AREAS**, parking space, portions of loading docks outside the building line, and **MAJOR VERTICAL PENETRATIONS**.

**FLOOR USABLE AREA** shall mean the sum of **USABLE AREAS** of **OFFICE AREAS**, **STORE AREAS** and **BUILDING COMMON AREAS** of a floor. The amount of **FLOOR USABLE AREA** can vary over the life of a building as corridors expand and contract and as floors are remodeled.
The Drive for Open Standard

BIM-Authoring Vendors
Autodesk & Inopso
Architectural Desktop
Autodesk Revit
Bentley Architecture
Graphisoft ArchiCAD
Onuma Planning Stm.

BIM-Viewing/Analysis
Solibri Model Checker
PBS OCA 3D-4D-BIM Program

- Autodesk ADT
- Graphisoft ArchiCAD
- Autodesk Revit
- Onuma Planning System
- Bentley Architecture
Space Object
  Space Name
  Space Number (ID)
  Occupant Org. Name
  Client Space Type
Visualize by Over 10 Different Parameters: e.g., space, zones, billing, agency, etc.
Typical floor area and efficiency from 1800-F (GSA CO) Building

<table>
<thead>
<tr>
<th>Area</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Gross Building Area</td>
<td>94,961</td>
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<tr>
<td>Gross Measured Area</td>
<td>87,920</td>
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<tr>
<td>Vertical Penetration Area</td>
<td>2,917</td>
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<tr>
<td>Floor Rentable Area</td>
<td>85,003</td>
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<tr>
<td>Usable Office Area</td>
<td>68,938</td>
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<tr>
<td>Usable Building Common Area</td>
<td>4,706</td>
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<tr>
<td>Floor Usable Area</td>
<td>73,644</td>
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<tr>
<td>Floor Common Area</td>
<td>11,359</td>
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<tr>
<td>Basic Rentable Office Area</td>
<td>79,571</td>
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<tr>
<td>Basic Rentable Building Common Area</td>
<td>5,432</td>
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<tr>
<td>Total Rentable Area</td>
<td>85,003</td>
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<tr>
<td>USF/GSF</td>
<td>0.84</td>
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<td>Floor R/U</td>
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<tr>
<td>Programming</td>
<td>Construction</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
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<tr>
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<td></td>
</tr>
<tr>
<td>Phasing</td>
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</tr>
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</table>
PBS 3D-4D-BIM Program
Border Station Prototype, US-Canada Border —
— BIM-based design in support of project planning and alternative analysis

- site orientation, vehicular flow, structural alternatives, material choices, and construction means and methods were studied during the early programming phase
- visual animation, orientation trade-off, and pre-fabrication studies were carried out with the building information model
PBS 3D-4D-BIM Program
Eisenhower Executive Off Bldg, Wash D.C.

— A balance between security requirements and historical preservations

- a BIM and a Quicktime movie were constructed based on fabricator’s shop drawings, at 1/48” accuracy
- daylight and shadow were cast based on city’s longitude, latitude
- perspective of a pedestrian was simulated based on elevation and site dimensions
PBS 3D-4D-BIM Program
U.S. Courthouse, Portland, OR

— Improving the means of communications with the public, tenants, and bidding contractors

- a historical landmark undergoes a seismic upgrade with the installation of base isolators
- 4D modeling integrates design intent, structural engineers’ specifications, and a construction schedule into a single model
- the model and the animation fostered GSA’s communications with the public, tenants, and GC bidders
PBS 3D-4D-BIM Program
300 NLA Federal Bldg, Los Angeles, CA

— Model-based tenant phasing enables schedule reduction and improved cost predictability

- A fully occupied federal building will go through a 16-phase seismic upgrade and modernization
- Data integration, 4D-modeling, and the Decision Dashboard enable the team to reduce overall schedule by 19% while uncovering major errors in cost assumptions
- 4D-modeling provides an effective means for communication with the tenant agencies
Programming
- As-Built Documentation
- Program development/Feasibility

Concept Design
- Validate: program, circulation, egress, energy, urban, preservation, cost

Design Development / Const. Doc
- Production, coordination
- Mockup
- Phasing

Construction
- collision detection
- construction sequencing
- shop drawing, fabrication
- construction tolerance

Commissioning / Operation
- as-built documentation
- system conditioning and reporting
- spatial data management
PBS 3D-4D-BIM Program
Office Building, Houston, TX

— Design intent omissions uncovered and coordinated before construction bidding

- a new office building with innovative façade system
- building information modeling enabled early detection of design errors and omissions pertaining to the façade system
- the designer team was able to incorporate the findings, correct the drawings, and avoided costly change orders and RFI’s that would impact the project schedule
New Construction

San Francisco Federal Office
PBS 3D-4D-BIM Program

2005 AIA TAP BIM Award Winner Morphosis: New San Francisco Federal Building

Design Team Skin and Framing model

B.D.S. detail model
Programming

- As-Built Documentation
- Program development/Feasibility

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PBS 3D-4D-BIM Program
GSA Central Off Bldg, Wash D.C.

— Energy analysis and computational fluid dynamic simulation of an existing office building

- BIM and IFC enabled direct model exchange with an energy consultant for a simulation of the thermal condition and energy usage of an existing facility
- thermal zones, construction materials, insulation types, and window properties are analyzed by a DOE-2 based program, which simulated energy consumption based on the occupancy activities across a typical work day.
PBS Investment

**Objectives**
- excellence
- sustainable
- innovation

**Business Process**
- OCA programs
- LEED
- workplace 20.20

**Investment effectiveness?**

PBS Expenditure

**Objectives**
- conservation
- satisfaction
- operation

**Business Process**
- energy management
- customer relations
- performance measures

**Operation efficiency?**

**Information Basis**
- energy bills
- survey/complaints
- walkthrough inspection
- field measurements
- reactive measures
Where we are? The steps forward...
Establish Minimum Requirements:
  Spatial Program Validation
  High Business Value
  Achievable

Series 02—GSA BIM Guide for Spatial Program Validation

Support “Above and Beyond” 3D, 4D, and BIM applications:
  3D Laser Scanning, 4D Phasing, Energy Simulation, Coordination
  Project-by-Project Basis (don’t boil the ocean)

Series 01—GSA BIM Guide Overview
# Capital Investment & Leasing Program Call

**FY 2005**

U.S. General Service Administration
GSA Public Buildings Service
Office of Real Property Asset Management

http://rw-qnet-ocsa.gsa.gov

## Content Overview

### Standardized Industry Foundation Classes (IFC)-Based Building Information Models (BIM)

- Hazardous Materials Studies
- Security Studies - Progressive Collapse, Blast/Window Vulnerability
- Seismic Studies

### Required Documentation - Border Station New Construction

- Summary of Border Station Required Documentation - TBD
- SUBMITTED BY THE REGIONS INTO PIP - TBD

### Required Documentation - Courthouse New Construction

- Summary of Courthouse New Construction Required Documentation
- SUBMITTED BY THE REGIONS INTO THE PIP

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FY 2005 Capital Investment & Leasing Program
Final Call

December, 2005
FedBizOpps:

For all prospectus projects receiving design funding in FY2007 and beyond, a spatial program Building Information Model will be the minimum requirement for all new and modernization projects that will be submitted to Commissioner of the Public Buildings Service for Final Concept approvals.

Scope of Work:

… check with OCA for latest template and advice on customization
Ongoing 3D-4D-BIM Projects led by OCA:

**Spatial Program Validation**

Region 4  Tuttle Annex, GA

Region 5  Dirksen Federal Building, IL (and laser as well)
          Rockford Courthouse, IL

Region 10 Edith Green Federal Office, OR

R11/NCR  1800 F Street GSA CO, DC
          HCHB Dept of Commerce, DC
          St. Elizabeth’s Campus, DC (candidate; led by NCR)
Ongoing 3D-4D-BIM Projects led by OCA:

**Energy Simulation**
Region 8  Salt Lake City Courthouse, UT

**3D Laser Scanning**
Region 2  Brooklyn Post Office and Courthouse, NY
Region 4  Peachtree Summit Building, GA
          Miami Judicial Campus, FL

**Phasing**
Region 9  PJKK Federal Building, HI
Region 10 Edith Green Federal Building, OR
Center of Expertise: OCA’s 3D-4D-BIM Program

Program: ongoing projects
Advise Regions on Solicitation, Scope, Implementation, and Evaluation
Final Concept Review of Spatial BIM models
Manage Program Budget and Monitor Project Funding on BIM
Process Mapping, Metrics, Value
Compiling Best Practices (laser scanning, energy modeling, space)

Program: ongoing development (strategic next steps)
Developing BIM functionality on shipping BIM products
  — adopt and extend the IFC open international standard
  — in-kind contributions from 5 software products and counting
Automating BIM Review of Courts Design Guide
Energy and Operations, Post Occupancy Evaluation, Equipment, Operation
Center of Expertise: OCA’s 3D-4D-BIM Program

**Within PBS**

Collaborate with GSA Offices and Regions (Portfolio, SDM, Property Management, CIO, etc.)

Sponsor regional advocates to BIM training program

Solicit BIM project nominations from regions

**Industry Exchange**

International, National, and Local standards and professional organizations
PBS OCA 3D-4D-BIM Program

GSA’s National 3D-4D-BIM Program

From introduction, pilots, to policy and program implementation

• 10 OCA-led pilots completed
• 11 OCA-led pilots underway
• 25+ OCA supports on ongoing GSA projects
• Strategy and Tactics (funding, contracts, req’s)
• The GSA BIM Guide Series:
  01—Overview
  02—Spatial Program Validation
Drafting...  3D Laser Scanning,
  4D Phasing,
Energy Performance
and Operation,
Circulation Validation
01 - GSA BIM Guide Overview

Version 0.50 – November 1, 2006

GSA Building Information Modeling Guide Series

02 - GSA BIM Guide For Spatial Program Validation

Version 0.90 – November 1, 2006

United States General Services Administration (GSA)
Public Buildings Service (PBS)
Office of the Chief Architect (OCA)
3D-4D Building Information Modeling

Since 2003, the General Services Administration (GSA) through its Public Buildings Service (PBS) Office of Chief Architect (OCA) has established the National 3D-4D BIM Program. OCA has completed 10 pilot projects. It has 11 pilot projects underway in 12 federal agencies to better manage and assimilate building information modeling (BIM) applications in over 25 ongoing projects across the nation. The power of visualizing, coordination, simulation, and optimization from three-dimensional (3D), four-dimensional (4D), and BIM computer technologies allow GSA to more effectively meet customer design, construction, and program requirements. GSA is committed to a strategic and incremental adoption of 3D, 4D, BIM technologies.

There is a progression from 3D to 3D, 4D and BIM. While 3D models make valuable contributions to communications, not all 3D models qualify as BIM models since a 3D geometric representation is only part of the BIM concept.

Critical to successful integration of computer models into project coordination, simulation, and optimization is the inclusion of information—the "I" in BIM—to generate feedback. As a shared knowledge resource, BIM can serve as a reliable basis for decision making and reduce the need for re-gathering or re-formating information. GSA is currently exploring the use of BIM technology throughout a project’s lifecycle in the following areas: spatial program validation, 4D phasing, laser scanning, and sustainability, and costs design validation.

For all major projects (prospectus-level) receiving design funding in Fiscal Year 2007 and beyond, GSA will require spatial program BIMs to meet the minimum requirements for submission to OCA for final Concept approval by the PBS Commissioner and the Chief Architect. At the same time, all GSA projects are encouraged to deploy mature 3D, 4D, and BIM technologies—spatial program validation and beyond—at strategic project phases in support of specific project challenges. The following are highlights of the GSA National 3D-4D BIM Program:

- Established policies phase in 3D, 4D, and BIM adoption for all major projects.
- Leading 3D-4D BIM pilot application on current capital projects.
- Providing expert support and assessment for ongoing capital projects to incorporate 3D, 4D, and BIM technologies.
- Assessing industry readiness and technology maturity.
- Developed GSA-specific incentives for 3D-4D-BIM.
- Developed solicitation and contract language for 3D-4D-BIM services.
- Partnered with BIM vendors, professional associations, open standards organizations, and academic/research institutions.
- Formulating the GSA BIM Guide including:
  - Series 01 – 3D-4D-BIM Overview
  - Series 02 – Spatial Program Validation
  - Upcoming: 4D Phasing.

http://www.gsa.gov/bim
Handouts

Acknowledgements (in-kind contributions)

Autodesk Architectural Desktop + Inopso
Autodesk Revit
Bentley Architecture
Graphisoft ArchiCAD
Onuma Planning System
Office of the Chief Architect

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Office of the Chief Architect

Calvin Kam, Ph.D.  [calvin.kam@gsa.gov]
National 3D-4D-BIM Program Manager
Center for Federal Buildings and Modernizations
Office of the Chief Architect

Peggy Ho, Caroline Clevenger , Eric Haun, Tobias Maile
Stanford University/CIFE Visiting Fellows

BIM Champions from GSA Regions:
Region 4— Brian Kimsey, Cliff Antrobus
Region 5— Chuck Hardy, Richard Gee
Region 6— John Brumley
Region 9— Jill Manzi, Mark Levi
Region 11/NCR— Steve Hagan, Mark Velsey, Mark Ilich
and more......

http://www.gsa.gov/bim