Emerging Innovative Technologies
Driving Change

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Emerging Innovative Technologies Driving Change for Buildings, Eco-Districts and Smart / Sustainable / Resilient Cities
1. Widespread deployment and use of interoperable technology applications, also called Building Information Modeling (BIM).
Innovative Dynamic Path-Breaking Emerging Innovative Technologies

- Augmented Reality
- Big Data and Analytics
- BIM
- CAFM
- Capturing Reality
- Cloud Computer
- CMMS
- Cybersecurity
- Data Storage
- Digital Fabrication
- Fog Computing
- Gamification
- Geo-Spatial | GIS
- Internet of Things (IoT)
- Laser Scanning
- Messaging (email, sms, and beyond)
- Mobile
- Model Checking
- Pervasive Computing
- Sensors
- Simulation
- Social Networking and Media
- Specification Authoring
- Synchronization
- Virtual Reality
- Wearable Computing
BIM Guide Series 02: Spatial Program Validation

Why BIM Matters to GSA

- Cost-Effective Delivery
- High Performance Building
- Early Stage Definition of Projects
Business Problem Addressed by BIM

Figure 3-1- Facility Cycle

Facility Information

Planning  Design  Construction  Operation

Feedback

$ $$$$
Building Information Model

GSA has set a goal to require interoperable Building Information Models (BIM) on FY06 projects in support of improving design quality and construction delivery. The Office of the Chief Architect is developing scope guidelines and offering regional pilot opportunities to help the regions in meeting this requirement. During the initial phase, and in support of design reviews during the concept design stage for new construction and modernization projects, interoperable BIM delivery shall be a supplement to all existing submission requirements, including PBS CAD Standards. For additional information, see the online PBS Guide to Building Information Models at http://rw-cpnet-oca.gsa.gov/bim-guide. For questions or feedback, send a message to ifc.bim@gsa.gov.

Turnover Documents. Electronic and hard copy documentation on all building systems should be provided for the guidance of the building engineering staff and long-term asset management. Documents should show the actual elements that have been installed, how they performed during testing, and how they operate as a system in the completed facility. As examples, the
Minimum Requirement for Spatial Program BIM

All major projects that receive design funding in FY2007 and beyond are required to submit a spatial program BIM prior to final concept presentation.
Space Data in IFC

Space Number (ID)
Space Name
Agency Bureau Abbreviation
GUID
Floor
Height (geometry)
Net Area (geometry)
Usable Area (derived from geometry)
Volume (geometry)
Zone
XYZ Location
Space Name
Space Number
Space Category
Agency Bureau Abbrev.

Net: 646
Usable: 683
GSA BIM Guide Workflow

1. Building program space requirements
2. Design review
   - Net
   - Gross
   - Useable
   - Circulation
   - Office
   - Mechanical
3. Project deliverable requirements, standards
4. Bentley Architecture building and space modeling
5. IFC – BIM data exchange
6.Model and space analysis
7. Validating space “program requirements” versus “designed”
Objectives

- Documentation of Window Types to be renovated
- Provide model to design team

Philadelphia Custom House Envelope Repair

- Built in 1934
- 8 Roofs
- 1050 Windows
White Oak CUP

Objectives
• Provide as-built BIM model
• Compare traditional measurement process with 3D Laser Scanning Process
Early Concept Design
<table>
<thead>
<tr>
<th>#</th>
<th>Design parameter</th>
<th>Type</th>
<th>Target Value</th>
<th>2Courts Actual Value</th>
<th>4Courts Actual Value</th>
<th>6Courts Actual Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of Building Floors</td>
<td>EA</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Total building gross area</td>
<td>Area (nsf)</td>
<td>208,755</td>
<td>220,000</td>
<td>224,464</td>
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<tr>
<td>3</td>
<td>Inside parking area</td>
<td>Area (nsf)</td>
<td>21,679</td>
<td>26,729</td>
<td>23,314</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Total gross minus inside parking area</td>
<td>Area (nsf)</td>
<td>187,076</td>
<td>193,271</td>
<td>201,150</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Total usable area</td>
<td>Area (usf)</td>
<td>162,237</td>
<td>178,749</td>
<td>182,414</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Atrium area</td>
<td>Area (nsf)</td>
<td>4,322</td>
<td>8,251</td>
<td>974</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Building Efficiency (USF/Total gross minus parking area)</td>
<td>Ratio (%)</td>
<td>67%</td>
<td>87%</td>
<td>92%</td>
<td>91%</td>
</tr>
<tr>
<td>8</td>
<td>Number of Courtrooms</td>
<td>EA</td>
<td>11</td>
<td>12</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Number of Special Proceedings/Appeals Courtrooms</td>
<td>EA</td>
<td>Not found</td>
<td>Not found</td>
<td>Not found</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Number of Chambers</td>
<td>EA</td>
<td>11</td>
<td>11</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Number of Inside Parking Spaces</td>
<td>EA</td>
<td>47</td>
<td>58</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Number of Elevator Spaces on the 1st Floor</td>
<td>EA</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td></td>
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<tr>
<td>13</td>
<td>Elevator Ratio (Total Gross Area / Number of Elevator Spaces)</td>
<td>Area (nsf)</td>
<td>25,000</td>
<td>29,822</td>
<td>36,667</td>
<td>24,940</td>
</tr>
<tr>
<td>14</td>
<td>Floor to Floor Height for Courtroom</td>
<td>Height (ft)</td>
<td>20</td>
<td>22.0, 8.0, 15.0</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>15</td>
<td>Maximum Ceiling Height of Courtroom</td>
<td>Height (ft)</td>
<td>16</td>
<td>9.0, 16.0</td>
<td>9.0, 16.0</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>Floor to Floor Height for Sp. Proceedings/Appeals Courtroom</td>
<td>Height (ft)</td>
<td>18</td>
<td>Not found</td>
<td>Not found</td>
<td>Not found</td>
</tr>
<tr>
<td>17</td>
<td>Maximum Ceiling Height of Sp. Proceedings/Appeals Courtroom</td>
<td>Height (ft)</td>
<td>14</td>
<td>15.0, 22.0</td>
<td>15.0, 22.0</td>
<td>22.0, 15.0</td>
</tr>
<tr>
<td>18</td>
<td>Floor to Floor Height for Office Space</td>
<td>Height (ft)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>Maximum Ceiling Height of Judges Chamber</td>
<td>Height (ft)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>Total Gross Area to Building Skin Area</td>
<td>Ratio (%)</td>
<td>45-55%</td>
<td>58%</td>
<td>71%</td>
<td>85%</td>
</tr>
<tr>
<td>21</td>
<td>Main Entrance’s floor level (Ground Level)</td>
<td>Not found</td>
<td>(Level 1)</td>
<td>Level 1</td>
<td>Level 1</td>
<td>Level 1</td>
</tr>
<tr>
<td>22</td>
<td>USMS Administrative Office’s floor level</td>
<td>2nd or upper</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Ground floor</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Gross Area of Prisoner Circulation and Holding Cell Area</td>
<td>Area (nsf)</td>
<td>8,069</td>
<td>5,750</td>
<td>9,438</td>
<td></td>
</tr>
</tbody>
</table>
Automated Circulation Validation Using BIM

1. Court design guide
   - United States Courts Design Guide

2. Selected circulation issues
   - Define standard syntax and structure for Language

3. Normalize circulation issues
   - Reference back to Design Guide description

4. Show where design fails
   - Testing a courthouse model on Rule Checking SW

5. IFC Courthouse data

6. Generate rule set

Rule Sets
27,000 routes were tested using 302 circulation rules in approximately 20 seconds.
10 Years of TAP Award Winning BIM
BIM Awards 2005-2014

Education Thrives, Process Arrives, Design Survives

BIM Comes Alive

The 4th Annual AIA TAP BIM Awards reveal the liveliness BIM demonstrated in 2007—a year called a tipping point for this advanced technology tool set.

The fear that institutions of higher education were not hitting their groove with BIM is allayed with four awards in the academic category. One award went to a graduate studio that convinced university officials that modular housing could be done with BIM.
10 Years of TAP Award Winning BIM

Creating Stellar Architecture Using BIM
10 Years of TAP Award Winning BIM
Creating Stellar Architecture Using BIM

Fredric C Hamilton Building
Denver Art Museum

M.A. Mortenson Company

www.aia.org/tap
@aia_tap
10 Years of TAP Award Winning BIM
Creating Stellar Architecture Using BIM

Loblolly House
Kieran / Timberlake
10 Years of TAP Award Winning BIM

2008 Jury’s Choice Award

BIM Storm International
BIM Charrette

Kimon Onuma
CATEGORY A : CREATING STELLAR ARCHITECTURE USING BIM

BIM AWARD CITATION
Wayne L. Morse U.S. Courthouse Morphosis

Completed: 2006
Contractor: JE Dunn Construction
Owner: US General Services Administration
$78M
263,170 GSF
Eco-Districts & Virtual 3D Cities
The SW Ecodistrict
A VISION PLAN FOR A MORE SUSTAINABLE FUTURE

National Capital Planning Commission

JANUARY 2013
**What is an Ecodistrict?**

**Energy Today**
- Coal generated electricity
- Natural Gas
- Cogeneration Plant (burns natural gas)
- Renewable Energy

**Where does the energy come from?**

**SW Ecodistrict Goal**
Strive for a zero net energy district (the energy the district needs is produced from renewable resources within or close to the district).
<table>
<thead>
<tr>
<th>Building ID</th>
<th>Name</th>
<th>Address</th>
<th>Status</th>
<th>Date</th>
<th>Area</th>
<th>Floors</th>
<th>Stories</th>
<th>Height</th>
<th>Use</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>11235324</td>
<td>Building 1</td>
<td>123 Street</td>
<td>Existing</td>
<td>2010</td>
<td>100,000 sq ft</td>
<td>7</td>
<td>10</td>
<td>150 ft</td>
<td>Office</td>
<td></td>
</tr>
<tr>
<td>11235324</td>
<td>Building 2</td>
<td>123 Street</td>
<td>Existing</td>
<td>2010</td>
<td>150,000 sq ft</td>
<td>10</td>
<td>15</td>
<td>250 ft</td>
<td>Retail</td>
<td></td>
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<tr>
<td>11235324</td>
<td>Building 3</td>
<td>123 Street</td>
<td>Existing</td>
<td>2010</td>
<td>200,000 sq ft</td>
<td>20</td>
<td>20</td>
<td>300 ft</td>
<td>Residential</td>
<td></td>
</tr>
</tbody>
</table>

**Building Information**

- **Building ID**: 11235324
- **Name**: Building 1
- **Address**: 123 Street
- **Status**: Existing
- **Date**: 2010
- **Area**: 100,000 sq ft
- **Floors**: 7
- **Stories**: 10
- **Height**: 150 ft
- **Use**: Office
- **Remarks**: |

**Building Details**

- **Number of Stories**: 12
- **Total Area**: 1,200,000 sq ft
- **Total Net Area**: 1,000,000 sq ft
- **Floor Gross Area (Calculated)**: 1,200,000 sq ft
- **Floor Net Area (Calculated)**: 1,000,000 sq ft
- **Floor Gross Area**: 1,200,000 sq ft
- **Floor Net Area**: 1,000,000 sq ft

**Utilities Summary**

- **Electrical Load**: 500,000 kW
- **Water Consumption**: 1,000,000 gal
- **Gas Consumption**: 500,000 cu ft
- **Energy Efficiency**: 100%
- **Occupancy Level**: 100%
Further Improving That Visualization...
Analogue City Modeling
Data and the Facility and Urban Life Cycle
LIFECYCLE

BIM

Facility

Work Order

Dashboards

CAD

Budget

GIS

BAS
DMLSS FM Current Work Order Process

114,322 days per year to manage DMLSS FM Work Orders

114,322 Days x $992 Per Day Full Burdened Rate = $113,407,424

16,332 Days + 32,663 Days + 48,995 Days + 16,332 Days

Field Work Order Entry
DoD Wide 783,917 Work Request in 2012

Work Orders Data Entry at Desk
Go back to Workstation Enter into DMLSS FM

Work Orders Repairs
Send Field Tech to Respond

Work Orders Data Entry at Desk
Close out Work Order

DMLSS FM Data - Services Oriented Architecture

The tools used to demonstrate the concept are not selected as the only solutions possible, but to illustrate what type of an ecosystem could develop in the next version of DMLSS FM once a services oriented architecture is enabled. Other vendors are encouraged to demonstrate how their solutions fit into the DMLSS FM Ecosystem.
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- Internet of Things (IoT)

- Laser Scanning
- Messaging (email, sms, and beyond)
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- Pervasive Computing
- Sensors
- Simulation
- Social Networking and Media
- Specification Authoring
- Synchronization
- Virtual Reality
- Wearable Computing
Augmented Reality
Augmented Reality

Better present & sell your building projects through augmented reality

Architects, get more contracts. Building owners, sell at lightning speed.

Request a demo

Watch the video
BIG DATA: Street Score

Washington, D.C., is using StreetScore’s data in combination with 311 calls to work on better maintenance of specific streets.
Street Score assigns a score to a street view based on how safe it looks to a human (but using a computer).
http://streetscore.media.mit.edu/citymap.html
Technologies and Innovation
Moving from BIM to a Broad Range of Tools and Processes

SMART REALITY

MAKERS OF SMARTBIDNET - SMART COMPLIANCE - SMART INSIGHT

Mortenson construction

AIA Technology in Architectural Practice
www.aia.org/tap
@aia_tap
Technologies and Innovation
Moving from BIM to a Broad Range of Tools and Processes

Facility Management 2015
Smart Buildings, Smart Cities & Infinite Data

Orbi being used for City Planning and Management by Atlanta Mayor Reed
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BIM Storms, Hackathons
OGC TestBeds | Frameworks
NIST Global City Challenge
Revit My Drone
Using Revit in Google Cardboard (VR)
A Smart City uses location as an organizing principal to benefit residents, visitors, and businesses of a city (e.g., Calgary).
Two barriers currently exist to effective and powerful smart city solutions. First, many current smart city ICT deployments are based on custom systems that are not interoperable, portable across cities, extensible, or cost-effective. Second, a number of architectural design efforts are currently underway (e.g. ISO/IEC JTC1, IEC, IEEE, ITU and consortia) but have not yet converged, creating uncertainty among stakeholders. To reduce these barriers, NIST and its partners are convening an international public working group to compare and distill from these architectural efforts and city stakeholders a consensus framework of common architectural features to enable smart city solutions that meet the needs of modern communities.
Global City Teams Challenge 2016

GCTC Tech Jam 2016

March 22-23, 2016 | Building 101
NIST Campus | Gaithersburg, MD

Agenda

Tuesday, March 22, 2016

8:00 am  Registration

8:45 am  OPENING PLENARY SESSION

Opening Remarks
   – Kent Rochford, Associate Director for Laboratory Programs, NIST
Global City Teams Challenge Overview and Tech Jam Objectives
   – Sokwoo Rhce, NIST

Keynote Address: Technology and the Future of Cities
   – Marjory Blumenthal, Executive Director, President’s Council of Advisors on Science & Technology at the White House Office of Science and Technology Policy (OSTP)

Fireside Chat: Executive Office Perspectives
   – Dan Correa, Senior Policy Advisor, OSTP

9:35 am  SMART CITIES: OPPORTUNITIES FROM THE PUBLIC AND PRIVATE SECTOR

GCTC Federal Partner Updates
   – National Science Foundation: Gurdeep Singh, Computer and Network Systems Program Director
   – National Telecommunications & Information Administration: Angela Simpson, Deputy Assistant Secretary for Communications and Information
   – Census Bureau: Avi Bender, Chief Technology Officer
On-demand deployable Virtual Endpoints

Multi-Service eXchange (Endpoint Socket) at the GW Virginia Campus/Equinix

WAN

CAAREN

HPC (Colonial One)

VM

DC as a Service
(Experimentation Platform – Urban Living Labs)

urban sensor hub
urban data repository
urban collection point
NEW SMART STREET CORNERS THAT WILL ACT LIKE A FITBIT FOR THE CITY

A rendering of what a sensor node will look like.
BIM (and Technologies) Execution Planning

Announcements:
- New Uses of BIM Document Released!
  
  The **Uses of BIM document** is designed to communicate the BIM Uses classification system and BIM Use Purposes.


Click to DOWNLOAD Click to DOWNLOAD
BIM (and Technologies) Execution Planning
Master Information Delivery Plan

The master information delivery plan is the primary plan for the preparation of the project information (from the supplier's perspective) required by the employer's information requirements. It lists information deliverables, and sets out when project information is to be prepared, by whom, and using what protocols and procedures for each stage of the project.
Technologies Execution Plan
Interoperable BIM | Geospatial | Urban Document and Data

- Augmented Reality
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Thank You

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