GEO BUIZ SUMMIT

Emerging Innovative Technologies Driving Change

Stephen R Hagan FAIA

President | CEO **Hagan Technologies LLC**

Emerging Innovative Technologies Driving Change

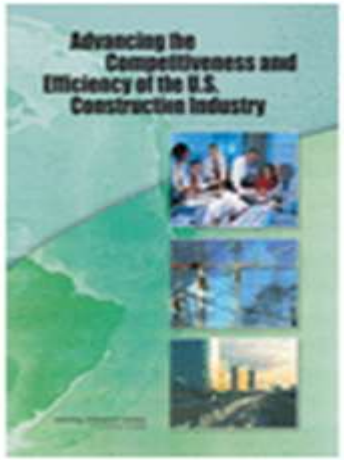
for

Buildings, Eco-Districts

and

Smart | Sustainable | Resilient Cities

1. *Widespread deployment and use of interoperable technology applications, also called Building Information Modeling (BIM).*



Advancing the Competitiveness and Efficiency of the U.S. Construction Industry

Committee on Advancing the Competitiveness and Productivity of the U.S. Construction Industry, National Research Council

ISBN: 0-309-14192-3, 122 pages, 6 x 9, (2009)

This free PDF was downloaded from:
http://www.nap.edu/catalog/12717.html

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

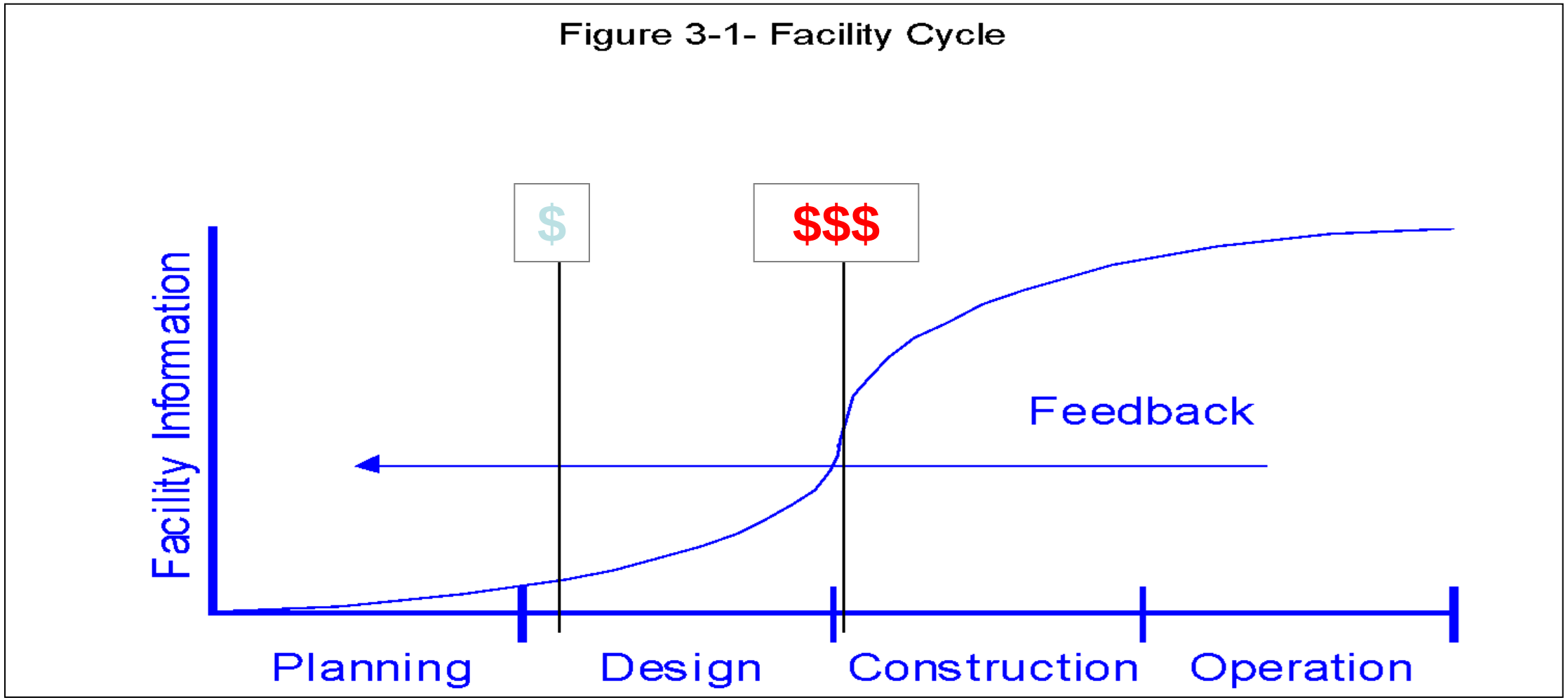
Why BIM Matters to GSA

Cost-Effective Delivery

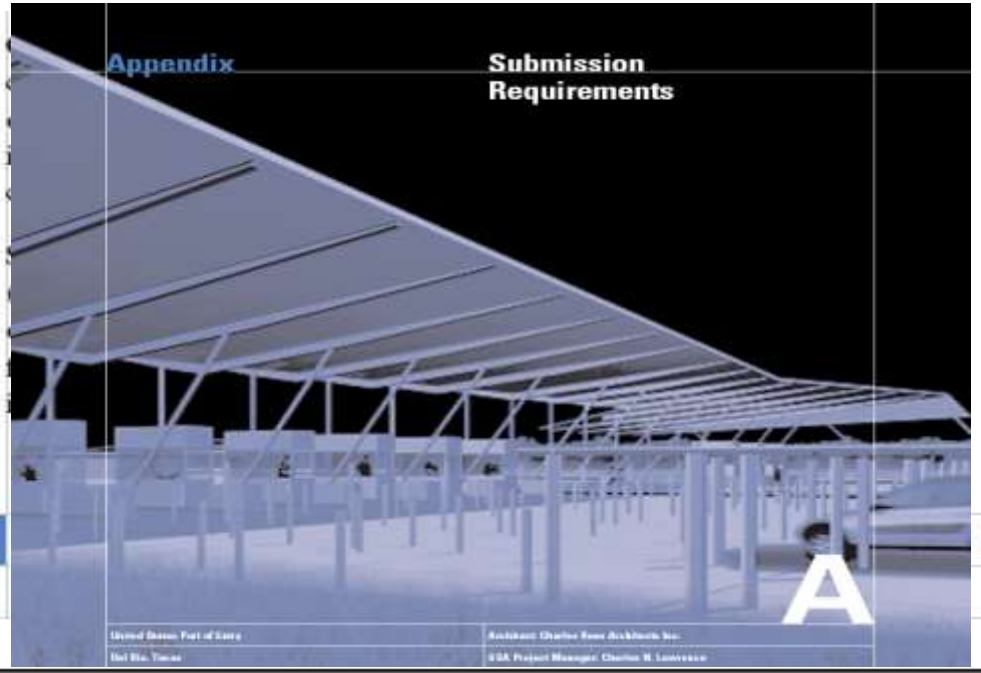
High Performance Building

Early Stage Definition of Projects

Business Problem Addressed by BIM



GSA Building Information Model Initiative



294
A.1

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-qpnet-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

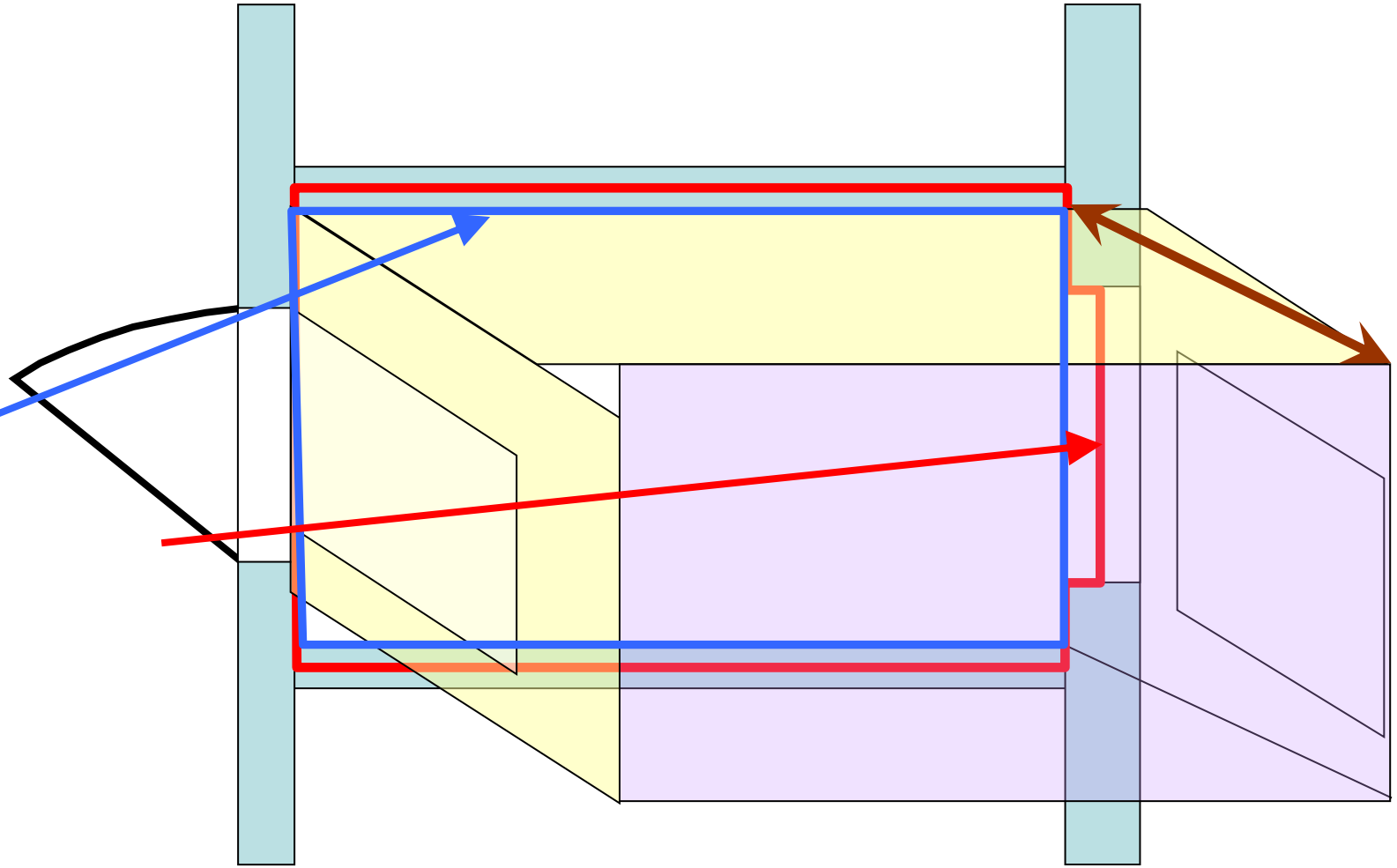
BIM Guide Series 02:
Spatial Program BIM

Minimum Requirement for Spatial Program BIM

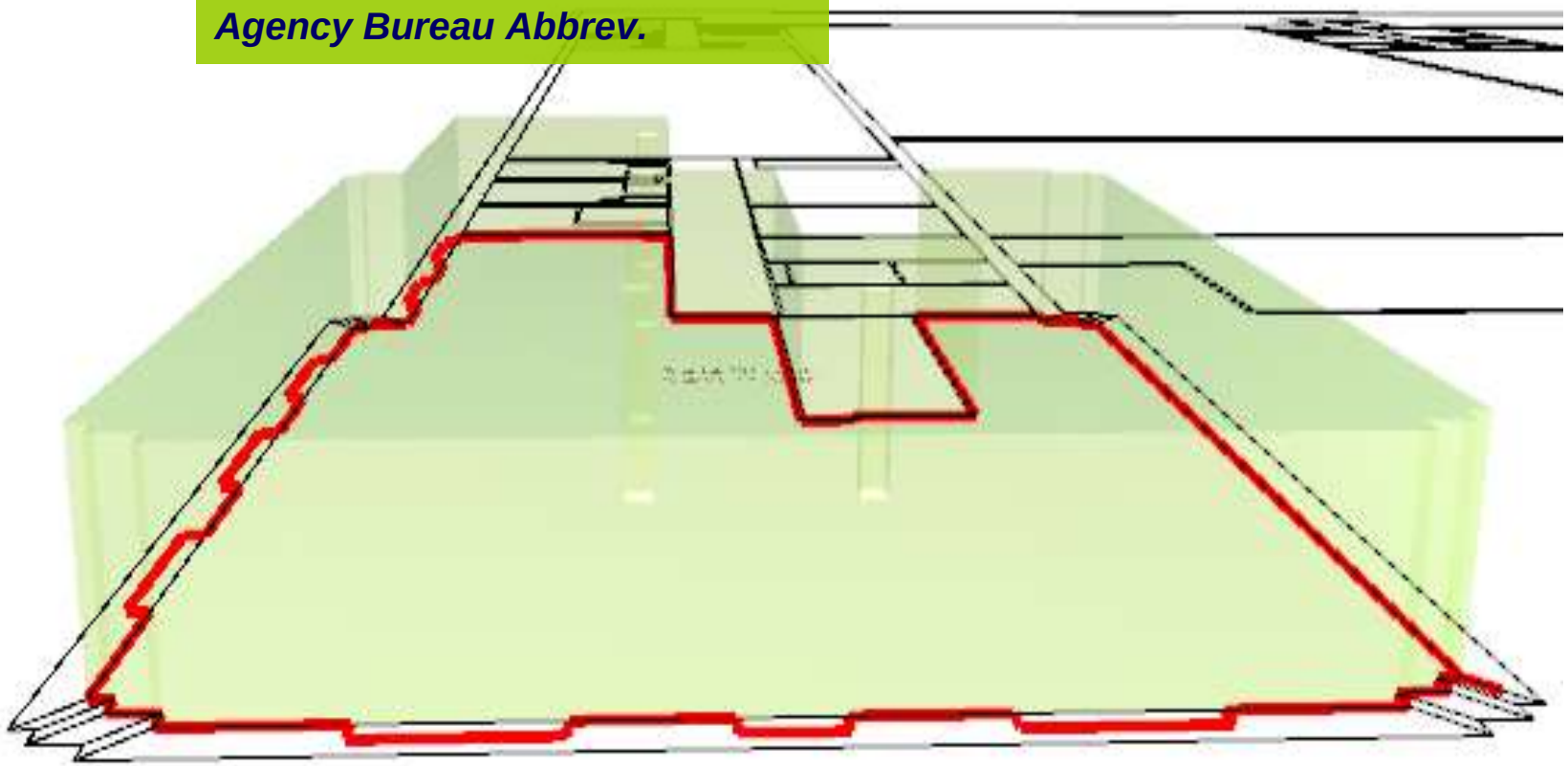
All major projects that receive design funding in FY2007 and beyond are required to submit a spatial program BIM prior to final concept presentation.

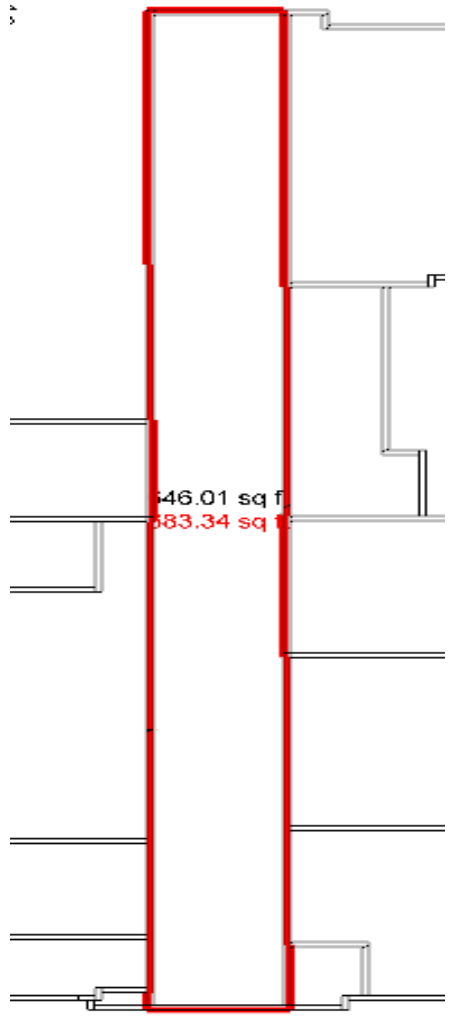
Space Data in IFC

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.



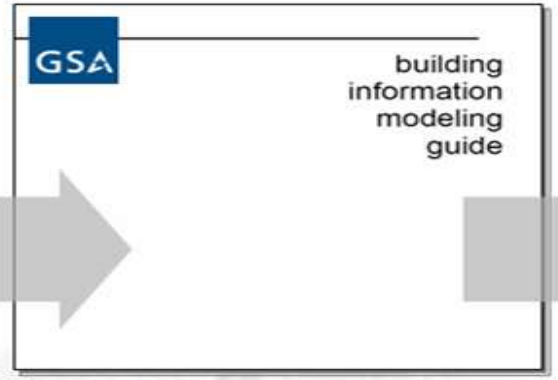


Net: 646
Usable: 683

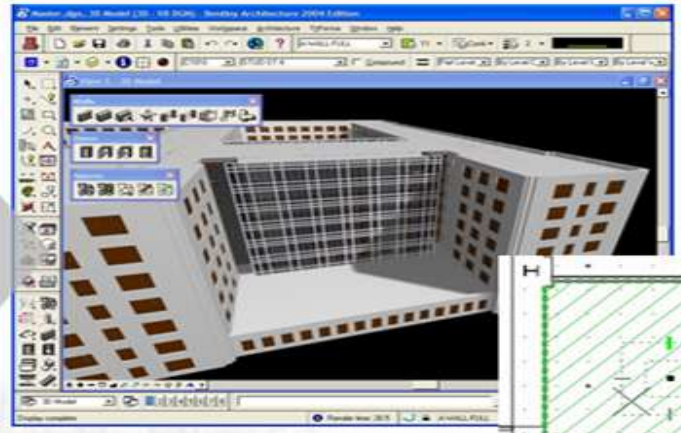
WWW.BENTLEY.COM/BUILDING

GSA BIM Guide Workflow

building program
space requirements



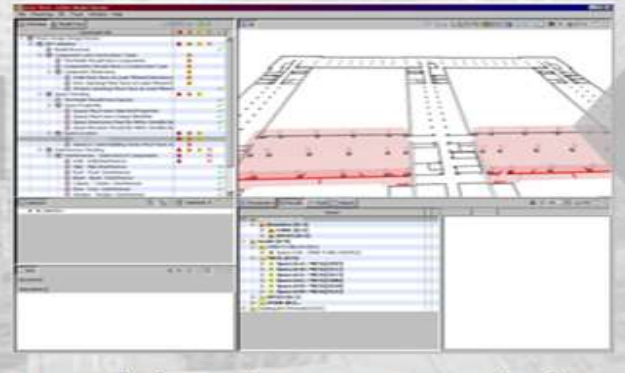
project deliverable
requirements, standards



Bentley Architecture
building and space modeling

IAI

IFC – BIM data
exchange



model and space analysis

validating space
“program requirements”
versus “designed”

BIM Guide Series 03: 3D Laser Scanning

Philadelphia Custom House
Envelope Repair

- Built in 1934
- 8 Roofs
- 1050 Windows

Objectives

- Documentation of Window Types to be renovated

- Provide model to design team

White Oak CUP

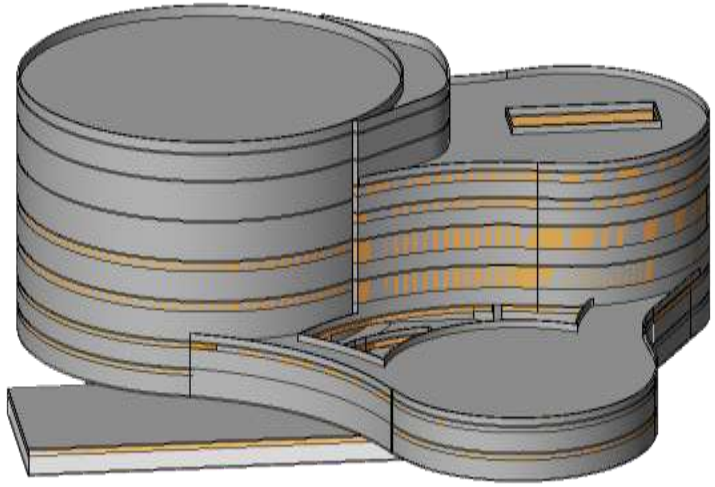
<u>Objectives</u>

- **Provide as-built BIM model**
- **Compare traditional measurement process with 3D Laser Scanning Process**

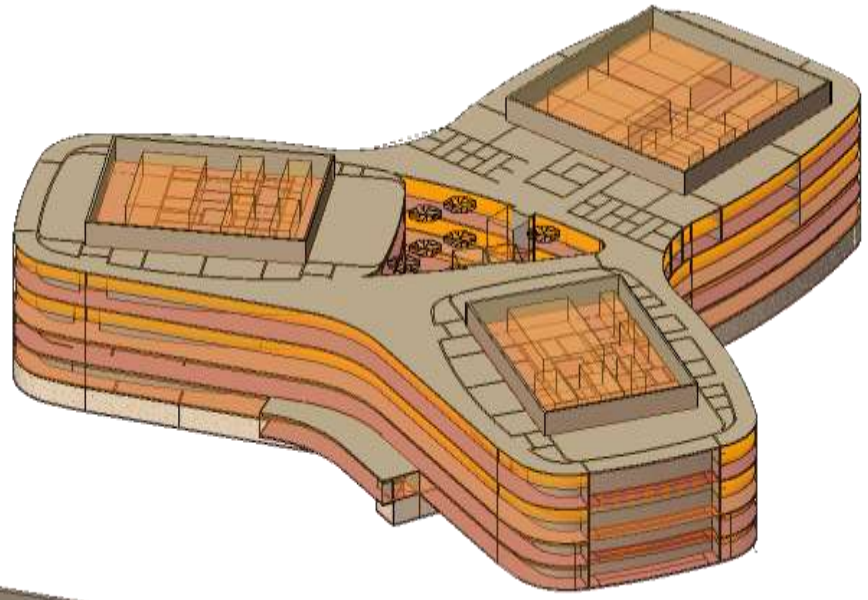
Early Concept Design

Georgia Institute of Technology

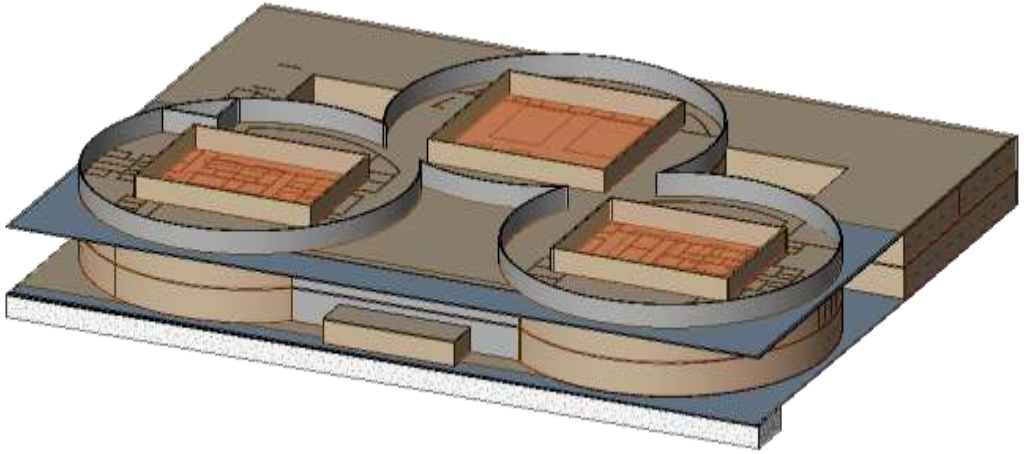
Toledo Courthouse



2 Courts/Floor



4 Courts/Floor



6 Courts/Floor

Georgia Institute of Technology

Early Space Program Review for Concept Design Evaluation
Project: U.S. Courthouse of Toledo, OH
(Jun 19, 2008)

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

Automated Circulation Validation Using BIM

Automated Circulation Validation Using BIM

Court design guide

Selected circulation issues

Define standard syntax and structure for Language

Normalized circulation issues

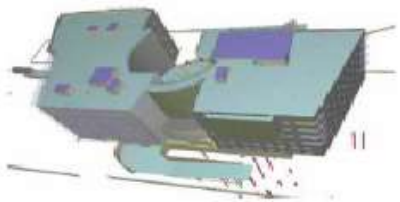
	A	B	C	D	E	F	G	H	I	J
19	A	original	cardinality	startspace	targetspace	carc	target space	target space	target space	security zo	usage
20	1	3-13-22	At least on	USDC clerk office	at least one		circulation	public	restricted	circulation
21	2	3-13-22	At least on	USCA clerk office	at least one		circulation	public	restricted	circulation
22	3	3-13-22	At least on	USBC clerk office	at least one				restricted	circulation

Reference back to Design Guide description

Show where design fails

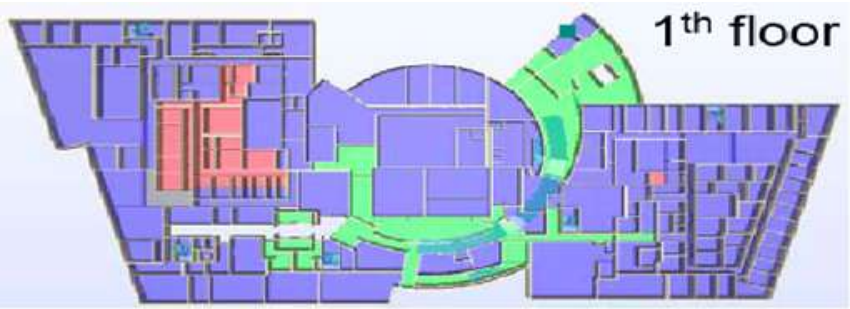
Generate rule set

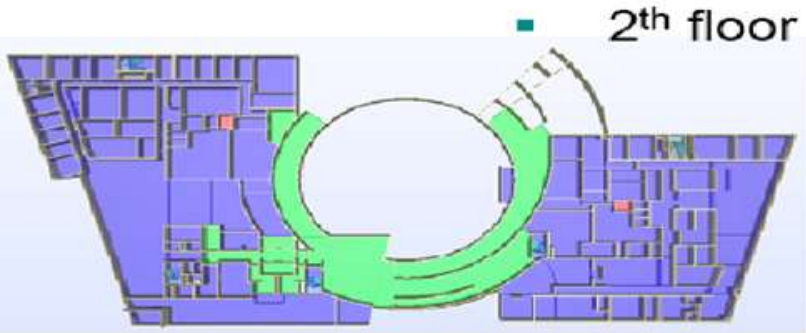
IFC Court house Data

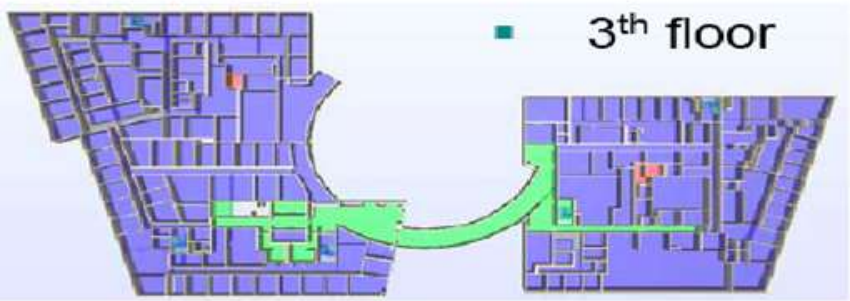


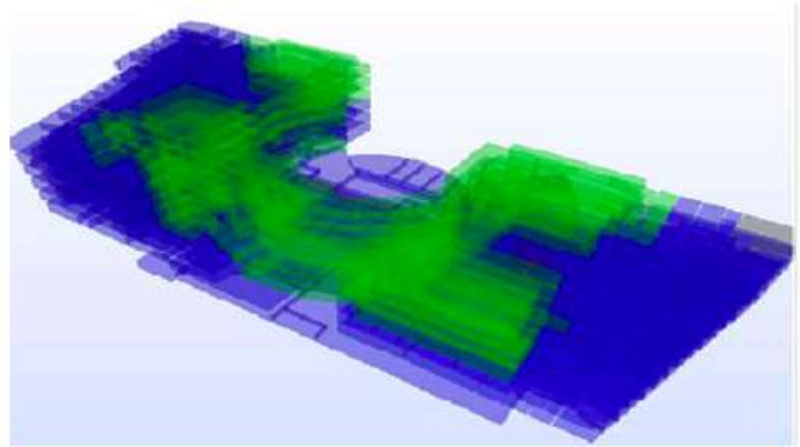
Testing a court house model on Rule Checking SW

Rule Sets

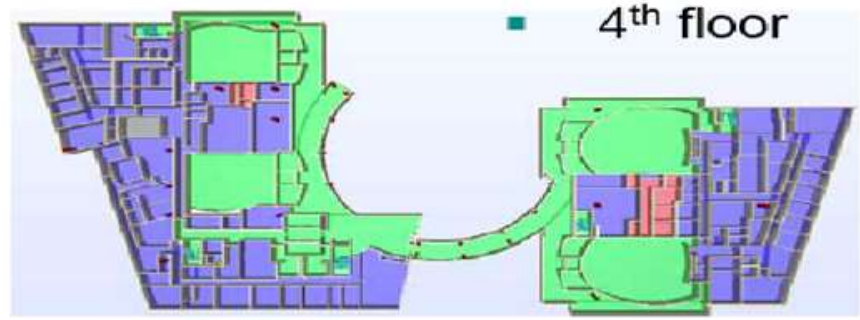


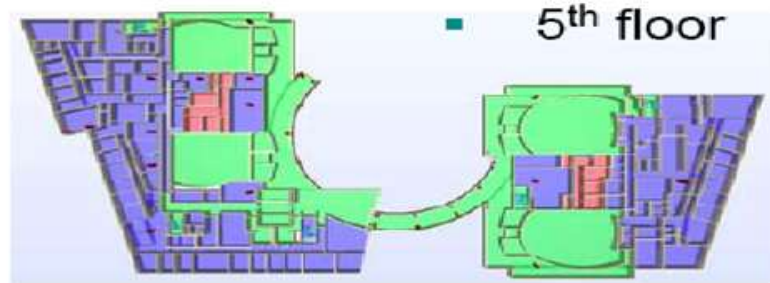


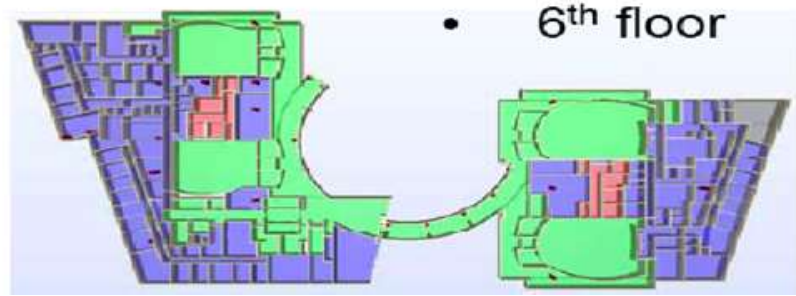


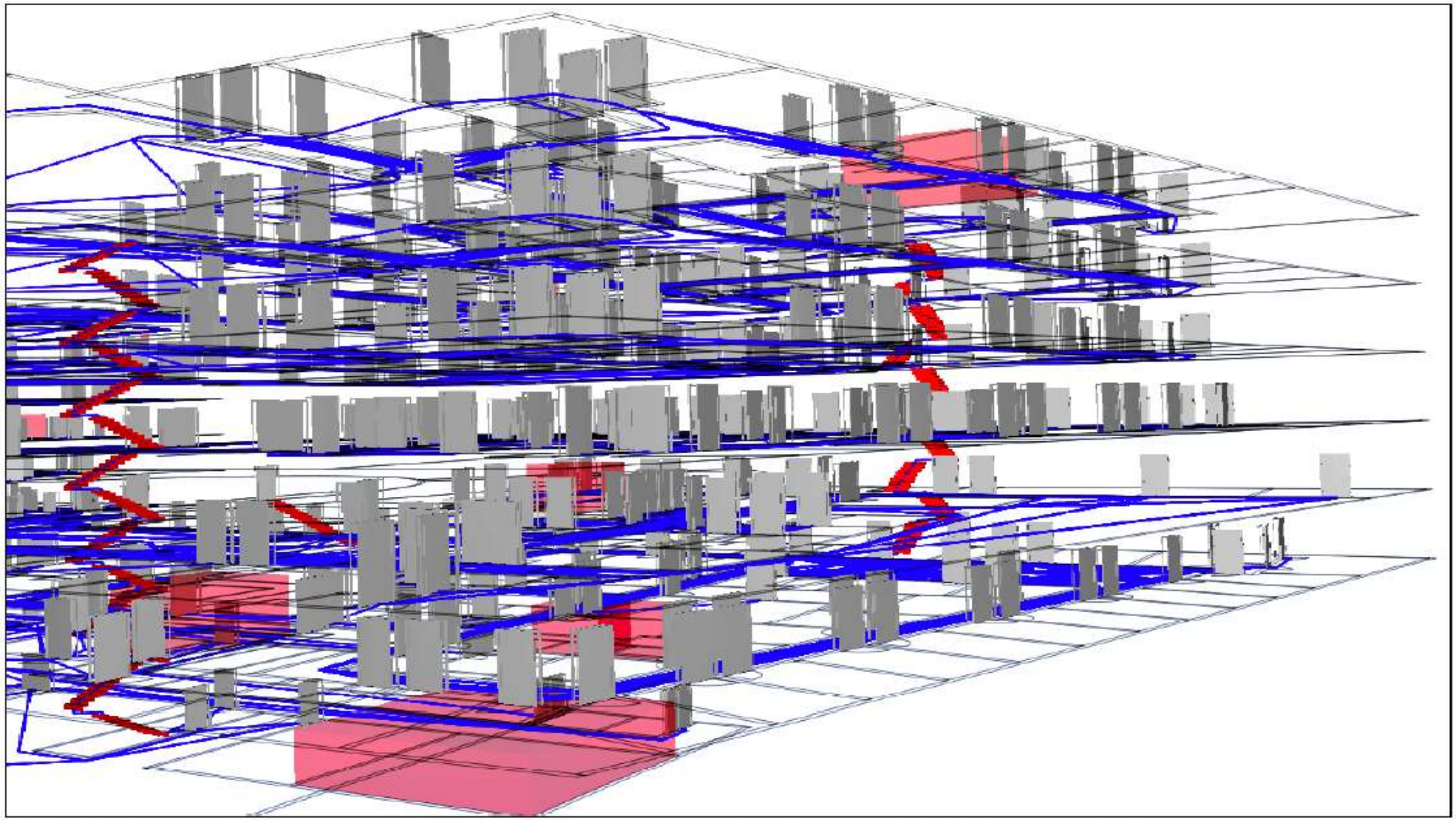


Public
Restricted
Secure









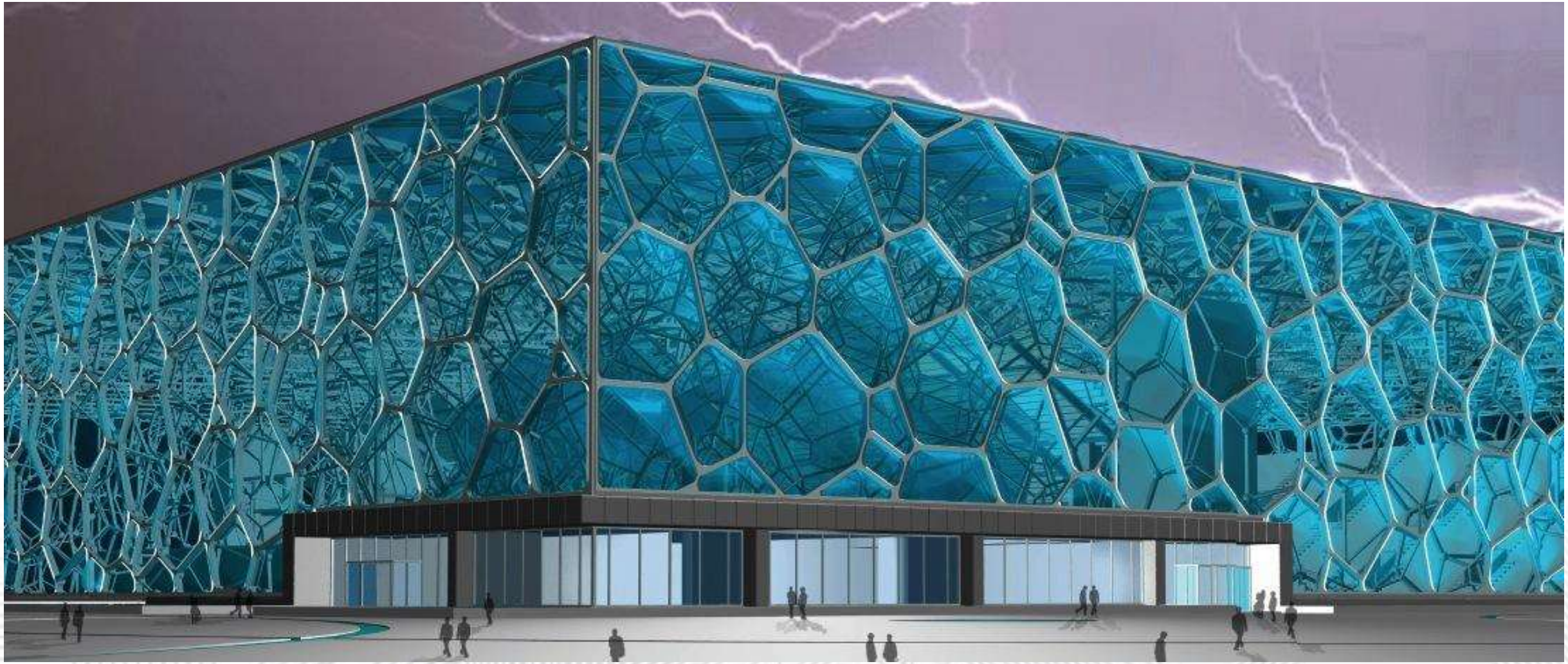
27,000 routes were tested using ***302 circulation rules*** in approximately ***20 seconds***.

10 Years of TAP Award Winning BIM

BIM Awards 2005-2014

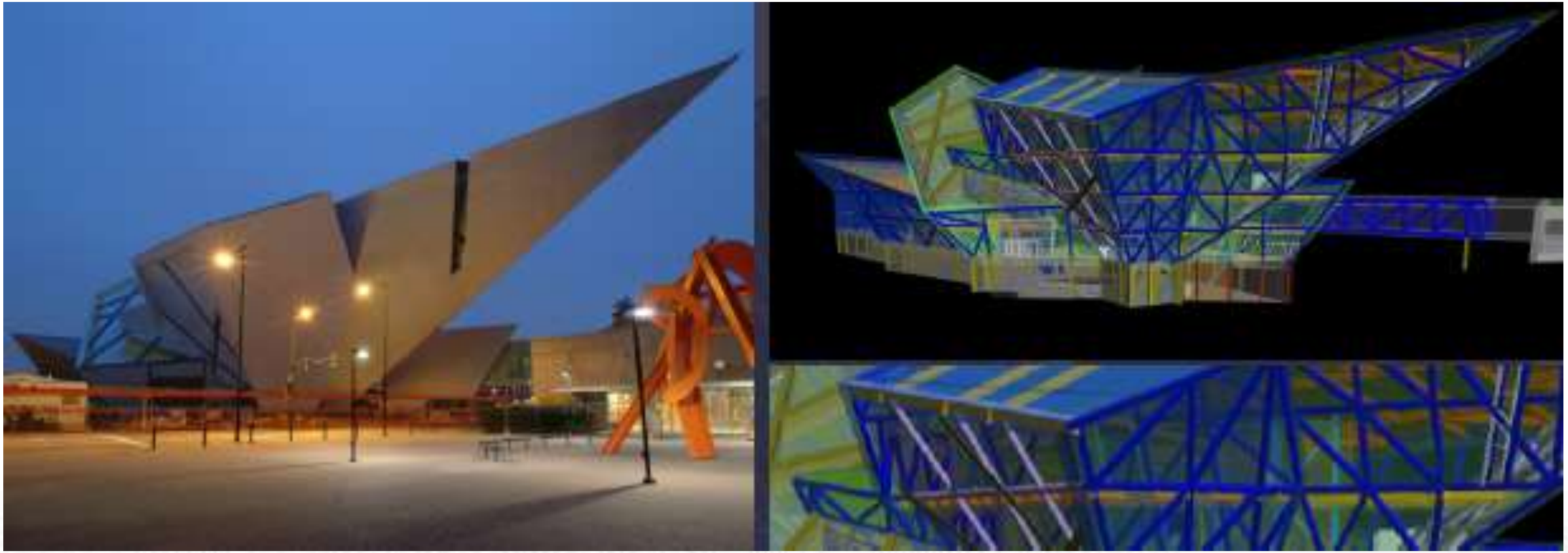
10 Years of TAP Award Winning BIM

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

10 Years of TAP Award Winning BIM

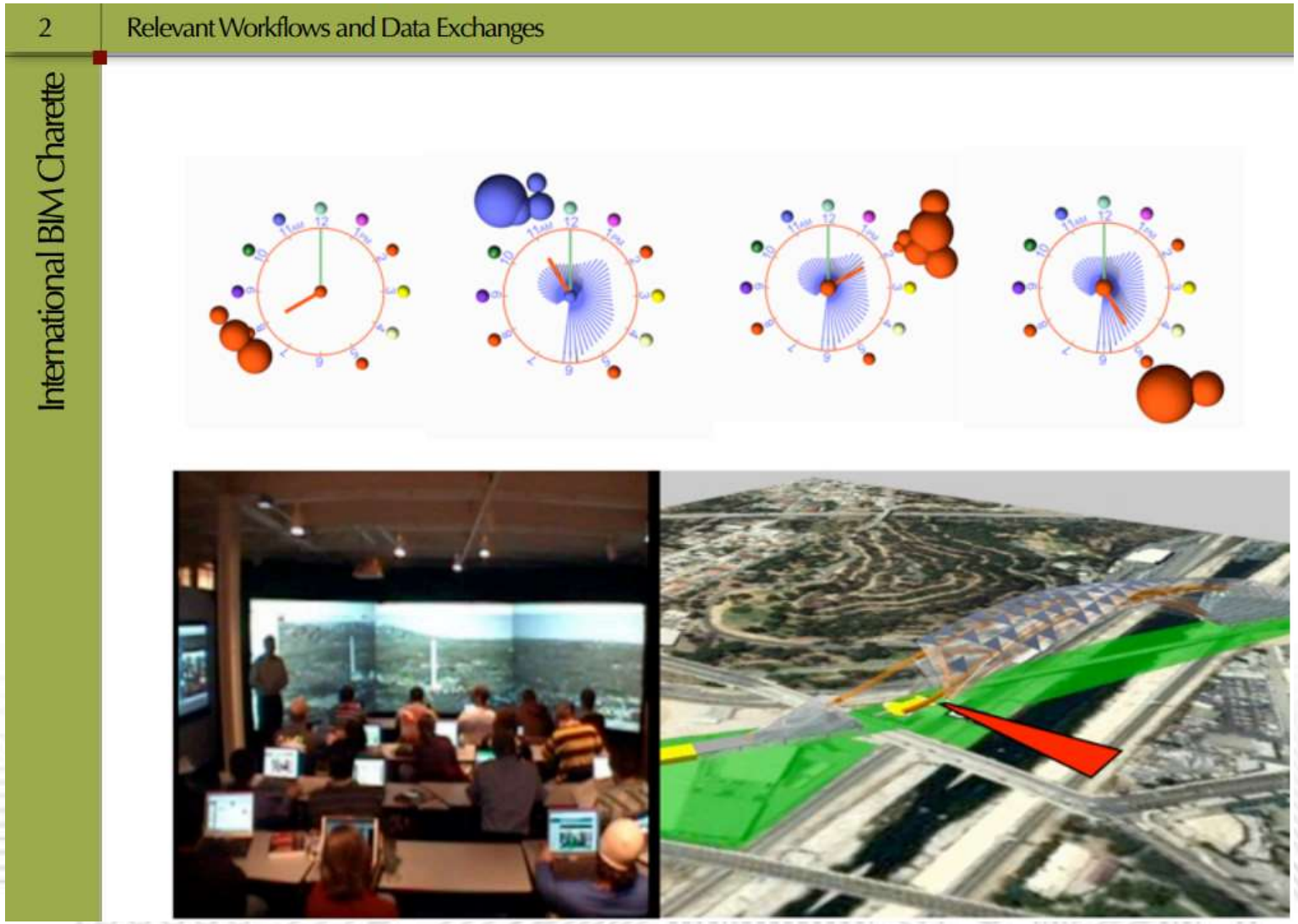
Creating Stellar Architecture Using BIM

Loblolly House

Kieran / Timberlake

10 Years of TAP Award Winning BIM

2008 Jury's Choice Award



BIM Storm International
BIM Charrette

Kimon Onuma

CHANGE THE WORLD

Harnessing BIM Technology
and Integrated Project Delivery
for Sustainable Design

May 13-14, 2008 | Boston
A Preconvention Workshop

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)

Ecodistrict

Source: NASA, NGA, USGS

Compare Buildings

Site Information

Name	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Massing) 2010	SW EcoDistrict Existing Condition 10 Street Corridor (Mas 2010
Scheme ID	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	(8123_9)	
Gallery Link	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery	BIM Gallery
Site Area	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres	112.73 Acres
Parking Indoor	0	425	809	0	5	82	0	0	0	310	

Building Information

Building ID	(8123_323)	(8123_324)	(8123_325)	(8123_326)	(8123_327)	(8123_328)	(8123_329)	(8123_330)	(8123_331)	(8123_332)	(8
Building Name	Forrestal Day Care	FAA	Forrestal	Cotton Annex	901 D St SW	GSA	950 12th St SW	USPS	Lenfant Office 13	Lenfant Plaza Hotel	Lenfant
Image											
Live Link	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma System	Building in Onuma Syst
Building Number	DC0394	DC0083	DC0593	DC5004	DC0343	DC0031	TBD	TBD	DC0376	DC0376	
Owner / Agency	Department of Energy	DOT	Department of Energy	N/A	Agriculture (1200), HHS (7500)	GSA				NTSB, HUD, ED, GSA	DOE(9900), DH

Building Areas

# of Floors	1	14	13	12	11	11	13	12	11	13	
Building Total Gross Area (Reported per building)	7,884 sqft	1,114,226 sqft	1,808,143 sqft	118,435 sqft	217,365 sqft	943,493 sqft	0 sqft	0 sqft	98,365 sqft	163,641 sqft	171
Building Total Net Area (Calculated)	7,769 sqft	1,104,479 sqft	1,775,965 sqft	87,441 sqft	410,788 sqft	922,379 sqft	929,889 sqft	676,443 sqft	456,740 sqft	850,086 sqft	456
Building Total Gross Area (Calculated)	7,884 sqft	1,114,184 sqft	1,808,106 sqft	118,460 sqft	217,354 sqft	943,542 sqft	980,051 sqft	716,276 sqft	98,324 sqft	163,656 sqft	171

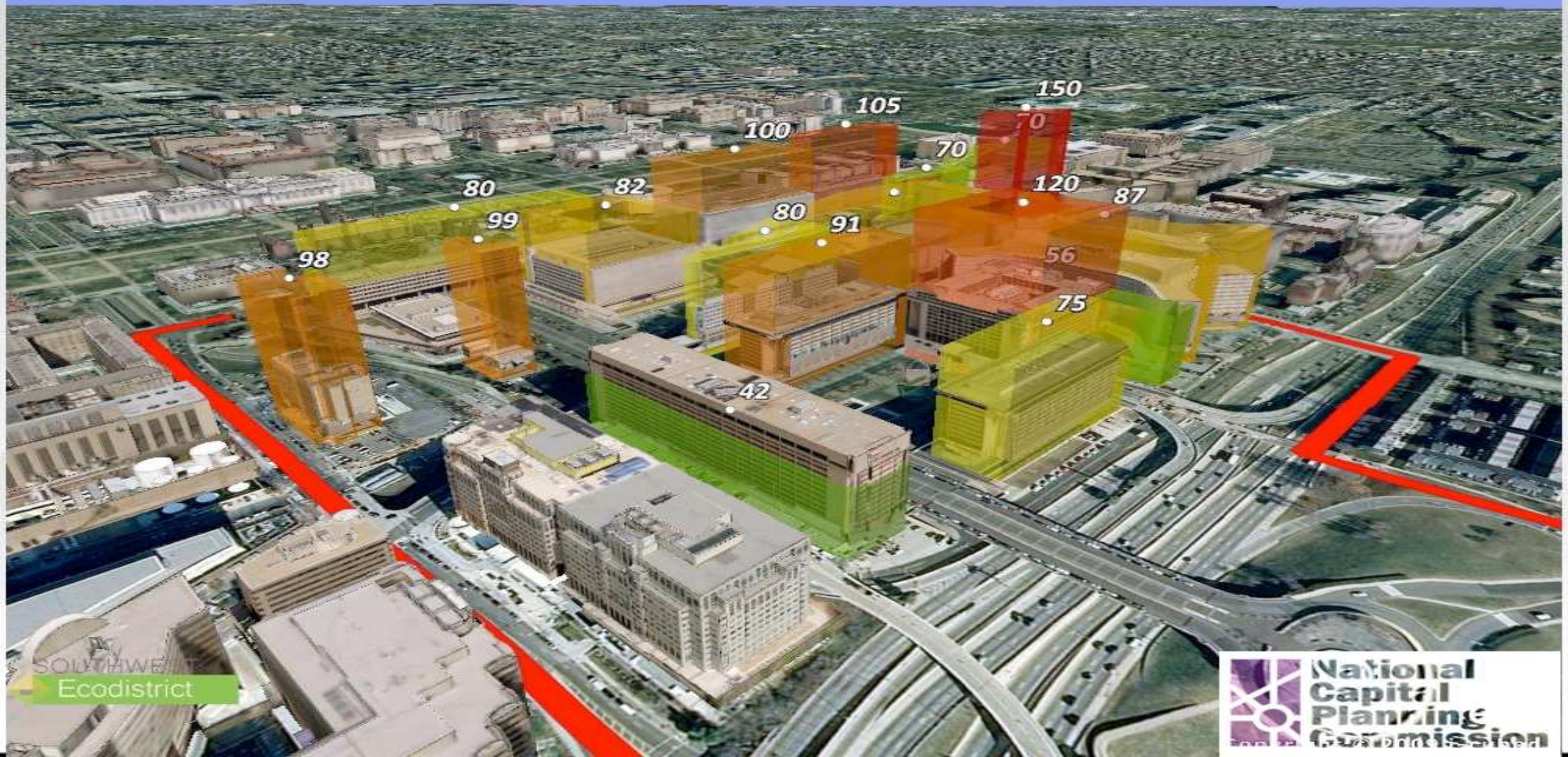
Building Occupancy

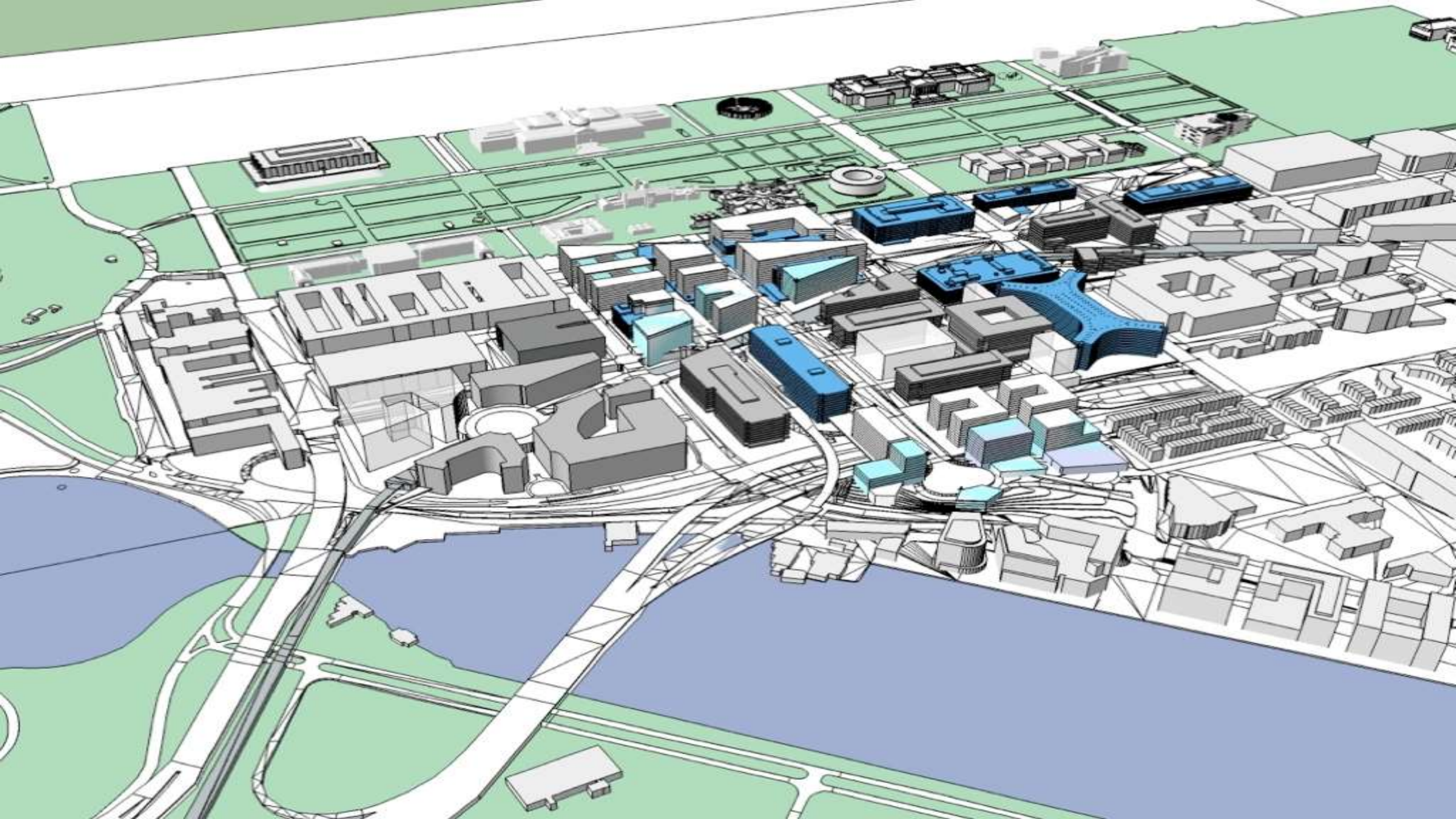
Building Type	1.2.3. - Educational	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.2.2. - Business	1.1. - Residential	1.2.2. - Business
# of Hotel Rooms	0	0	0	0	0	0	0	0	0	418	
Occupancy number (reported per building)	0	770	7,590	0	0	0	0	0	0	0	
Occupancy type (reported per building)		employees	employees								

Utilities Summary

Electricity Use(kWh / Year)	350,899	22,205,685	34,173,203	2,238,891	1,958,361	14,387,159	13,416,902	13,537,609	606,771	2,536,672	1
Renewable Electricity Use (kWh/Year)	0	686,171	238,308	0	0	437,613	0	0	0	0	
Energy Use (BTU/Year)	718,566,501	111,178,858,656	144,675,600,053	10,661,387,226	19,561,869,602	82,398,316,849	88,204,615,672	64,464,804,313	8,822,189,700	14,729,060,342	15,962
Steam (MLB/Year)	160	34,763	28,387	2,369	4,347	12,266	19,601	14,326	1,960	3,273	
Water (Gal/Year)	359,681	10,209,826	18,623	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,960,487	3,273,125	1
Natural Gas (CUFT/Year)	3,592	602,551	323,627	59,230	108,677	357,319	490,026	358,138	49,012	81,828	
Waste Water (Gal/Year)	119,761	16,712,761	0	1,776,896	3,260,312	14,153,129	14,700,769	10,744,134	1,470,365	2,454,843	2
Solid Waste (Tons/Year)	719	100,277	166,348	10,661	19,562	84,919	88,205	64,465	8,823	14,729	

Further Improving That Visualization...





Analogue City Modeling

Virtualcitysystems.de

Data and the Facility and Urban Life Cycle

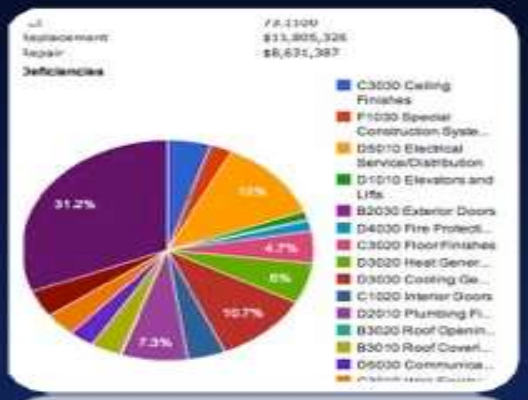
LIFECYCLE

BIM

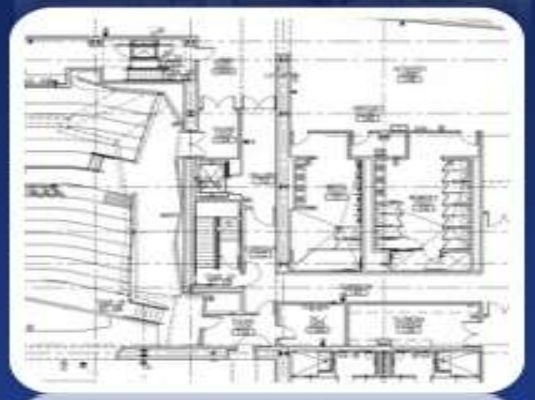
Facility

Work Order

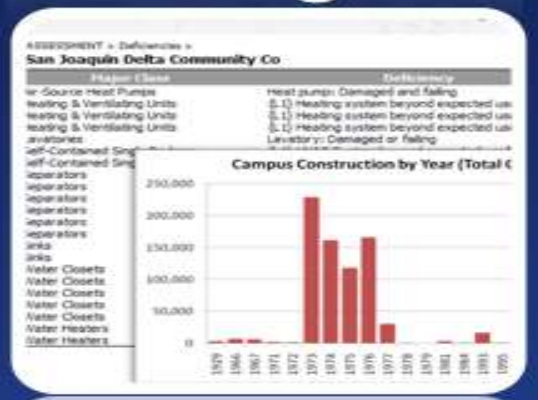
Dashboards



CAD

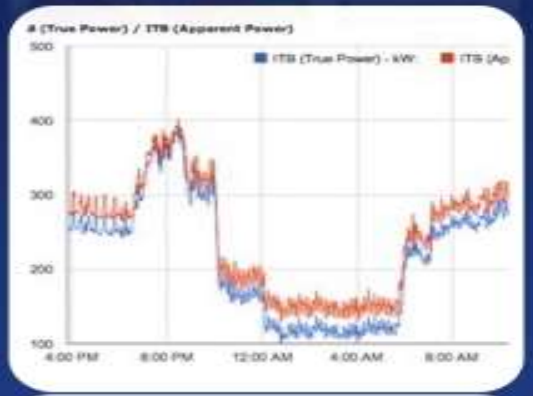


Budget

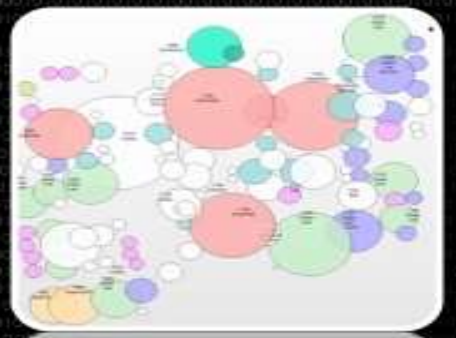


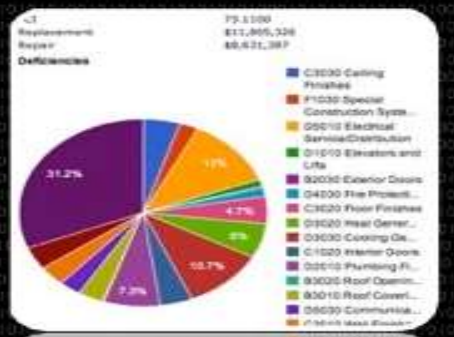
GIS

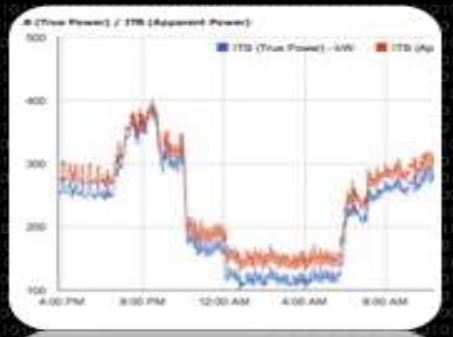
BAS



BIM

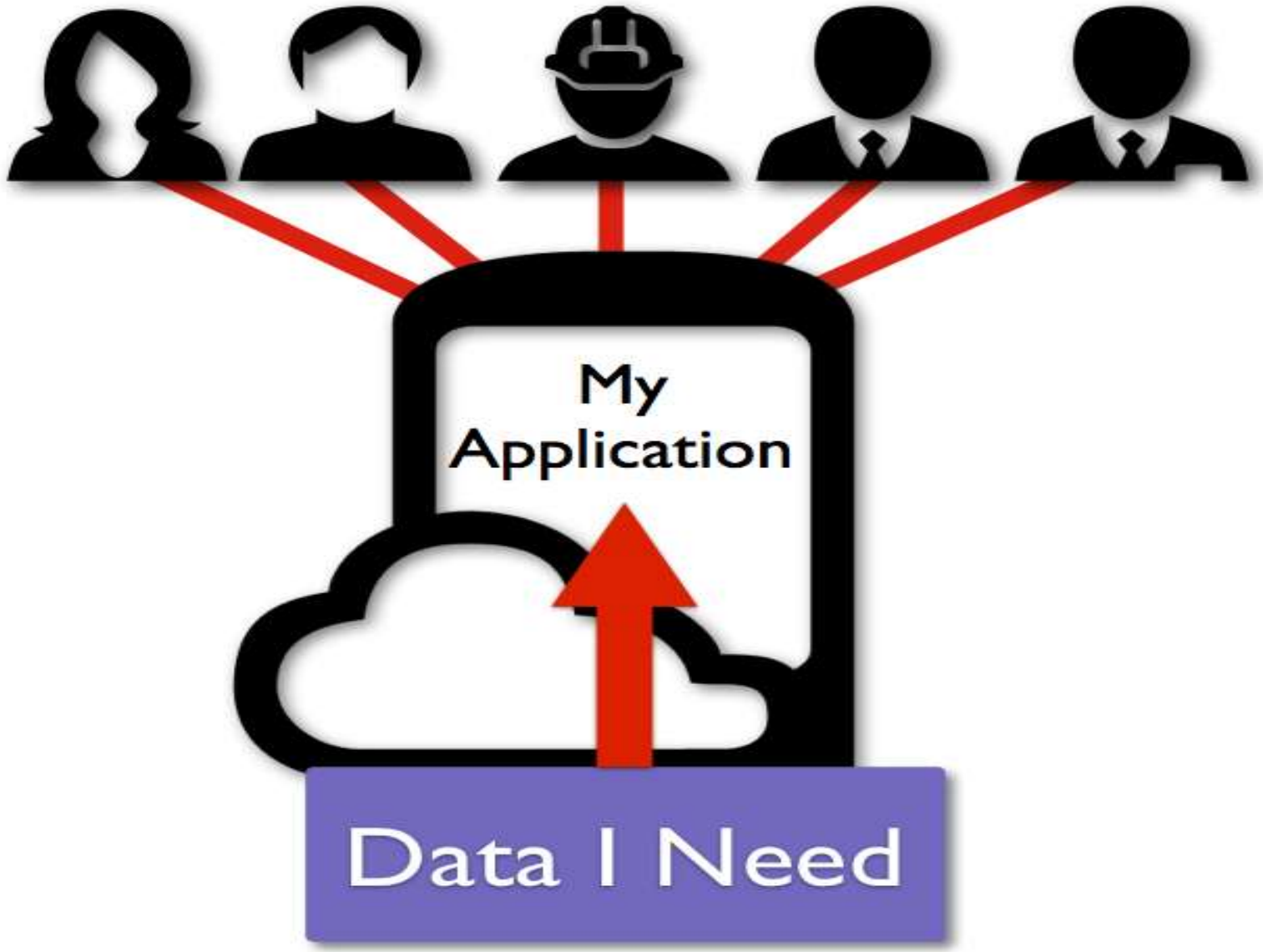




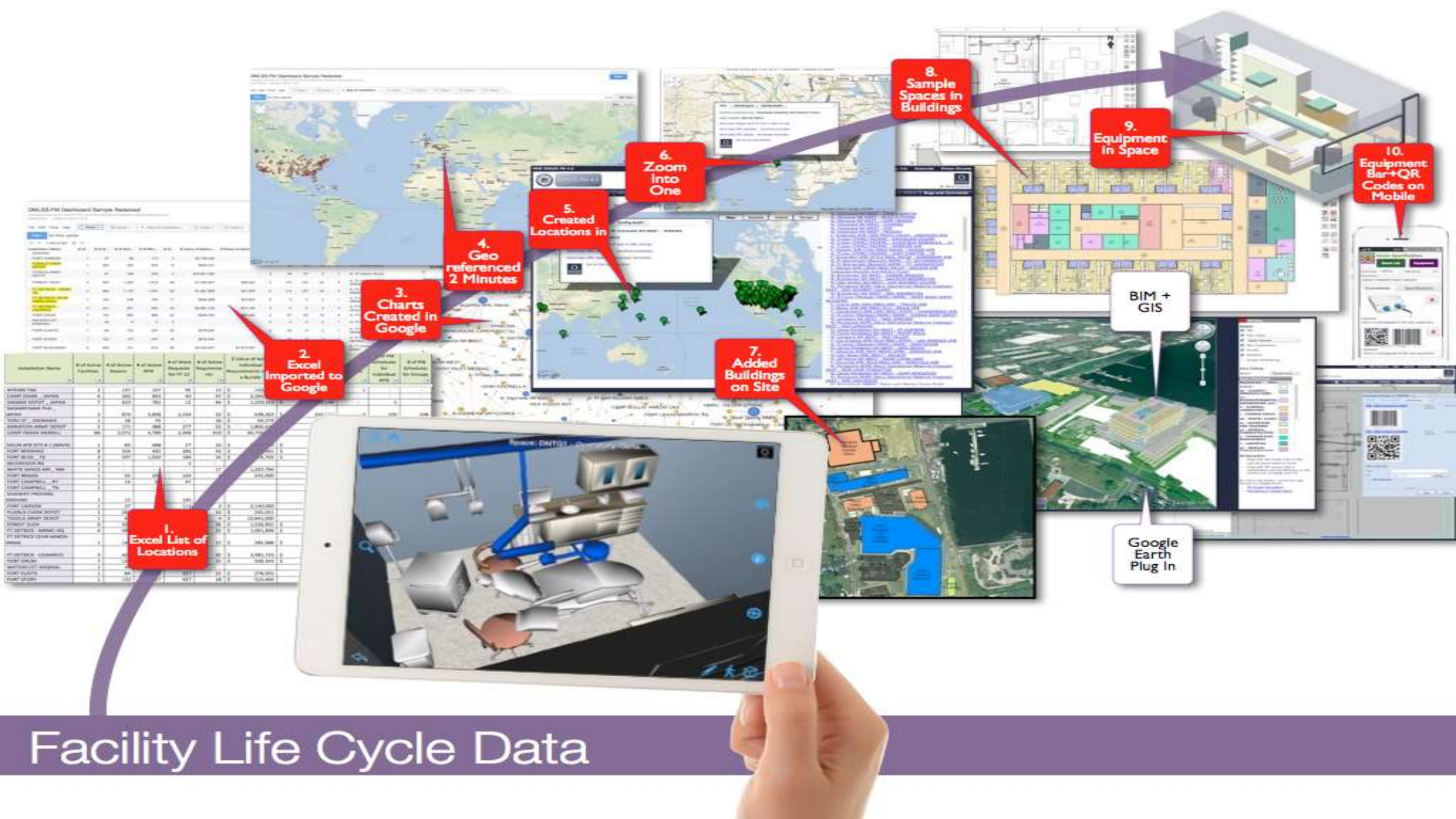


DATA

ONUMA



ONUMA



Facility Life Cycle Data

DMLSS FM Current Work Order Process

Imagine if this can be reduced by 30% per year

8

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

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

Calculated as 8 hour days

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

DoD Wide 783,917 Work Request in 2012

Go back to Workstation Enter into DMLSS FM

Send Field Tech to Respond

Close out Work Order

Hosted DMZ Test Environment from V3.5-v3.9

DMLSS FM Data - Services Oriented Architecture

MAX.GOV

(Or other Server)

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.

Innovative Dynamic Path-Breaking Emerging Innovative Technologies

- Augmented Reality
- Big Data and Analytics
- BIM
- CAFM
- Capturing Reality
- Cloud Computer
- CMMS
- Cybersecurity
- Data Storage
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- Internet of Things (IoT)
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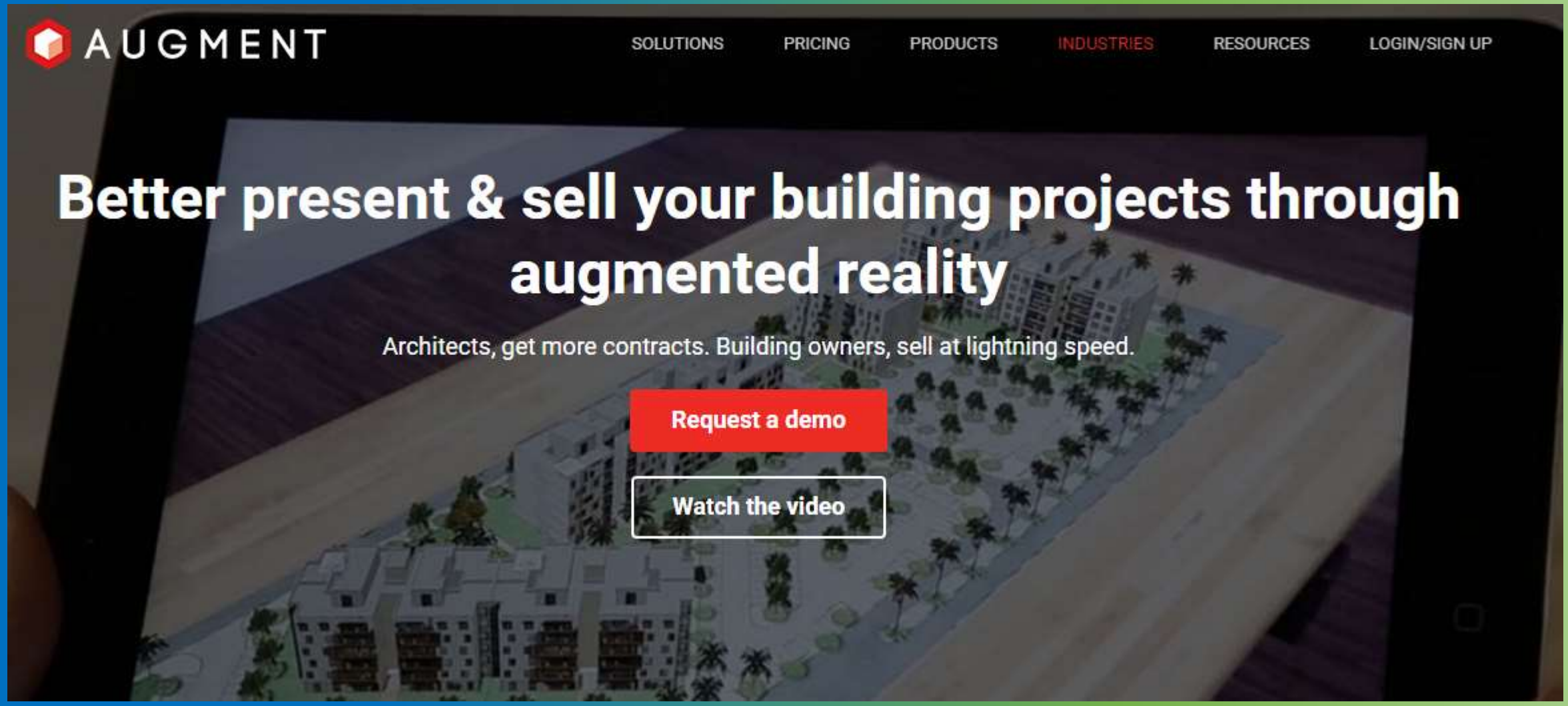
- Messaging (email, sms, and beyond)
- Mobile
- Model Checking
- Pervasive Computing
- Sensors
- Simulation
- Social Networking and Media
- Specification Authoring
- Synchronization
- Virtual Reality
- Wearable Computing

Augmented Reality

Augmented Reality



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

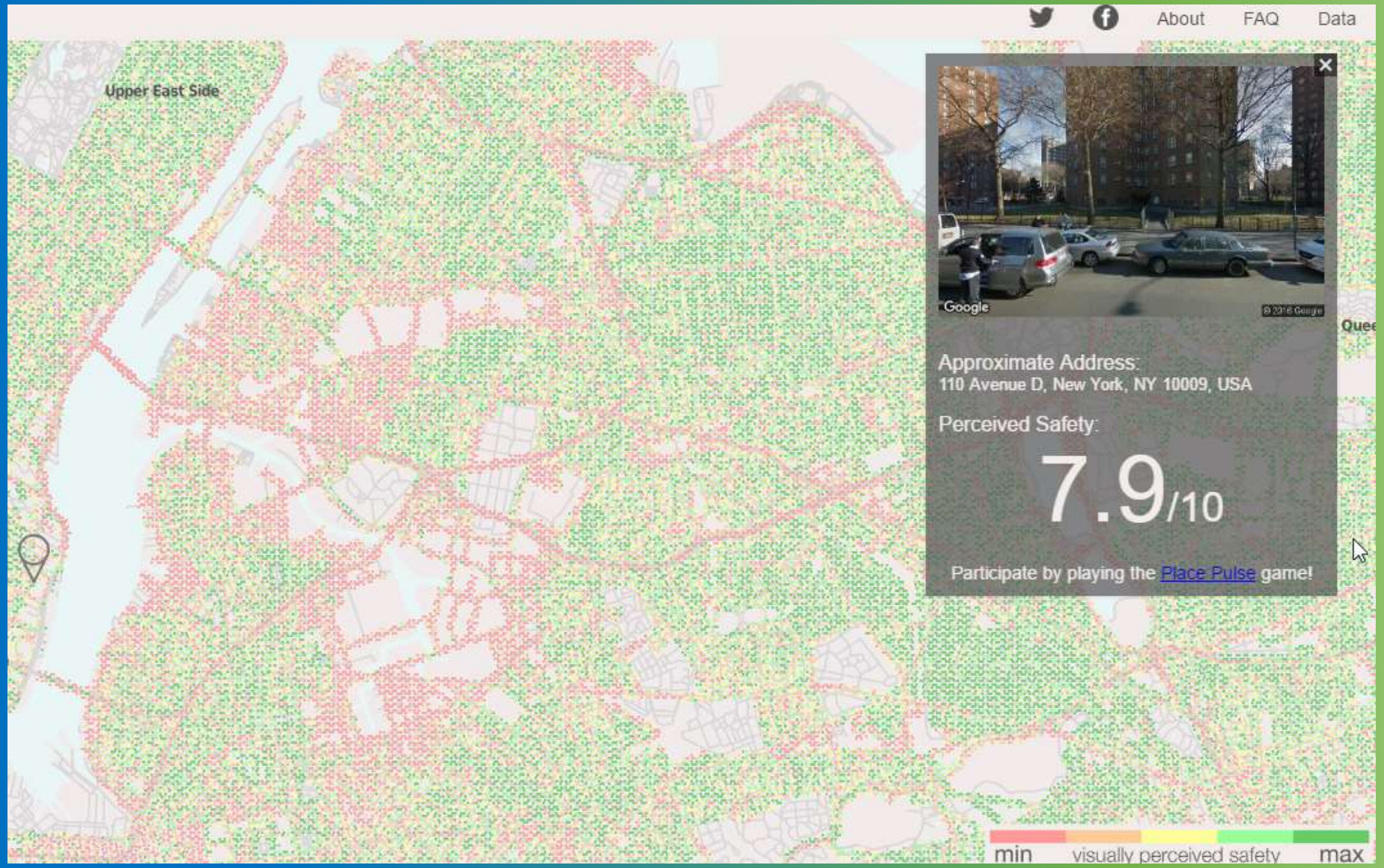
Please send your questions/comments to streetscore@media.mit.edu

StreetScore assigns a score to a street view based on how safe it looks to a human (but using a computer)

send your questions/comments to streetscore@media.mit.edu

StreetScore 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 · SMARTINSIGHT

Mortenson construction

Technologies and Innovation

Moving from BIM to a Broad Range of Tools and Processes

ENR EVENTS & CONFERENCES

FutureTech Conference 2014

GEORGIA TECH

ATLANTA, GA

#ENRTECH

Facility Management 2015

Smart Buildings, Smart Cities & Infinite Data

Atlanta

Orbi being used for City Planning and Management by Atlanta Mayor Reed

Innovative Dynamic Path-Breaking Emerging Innovative Technologies

- Augmented Reality
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BIM Storms, Hackathons OGC TestBeds | Frameworks NIST Global City Challenge

Creative Commons Attribution-Share Alike 3.0 Unported license. http://commons.wikimedia.org/wiki/File:Hong_Kong_Night_Skyline_non-HDR.jpg Photo by: Samuel Louie

Penn State iCon Lab and Prof. John Messner's Class Participating in BIMStorm LAX

AIA

Revit My Drone

AIA TAP

AIA

Using Revit in Google Cardboard (VR)

OGC® Smart Cities
Spatial Information Framework

A Smart City uses location as an organizing principal to benefit residents, visitors, and businesses of a
Calgary)

NIST IoT-Enabled Smart City Framework

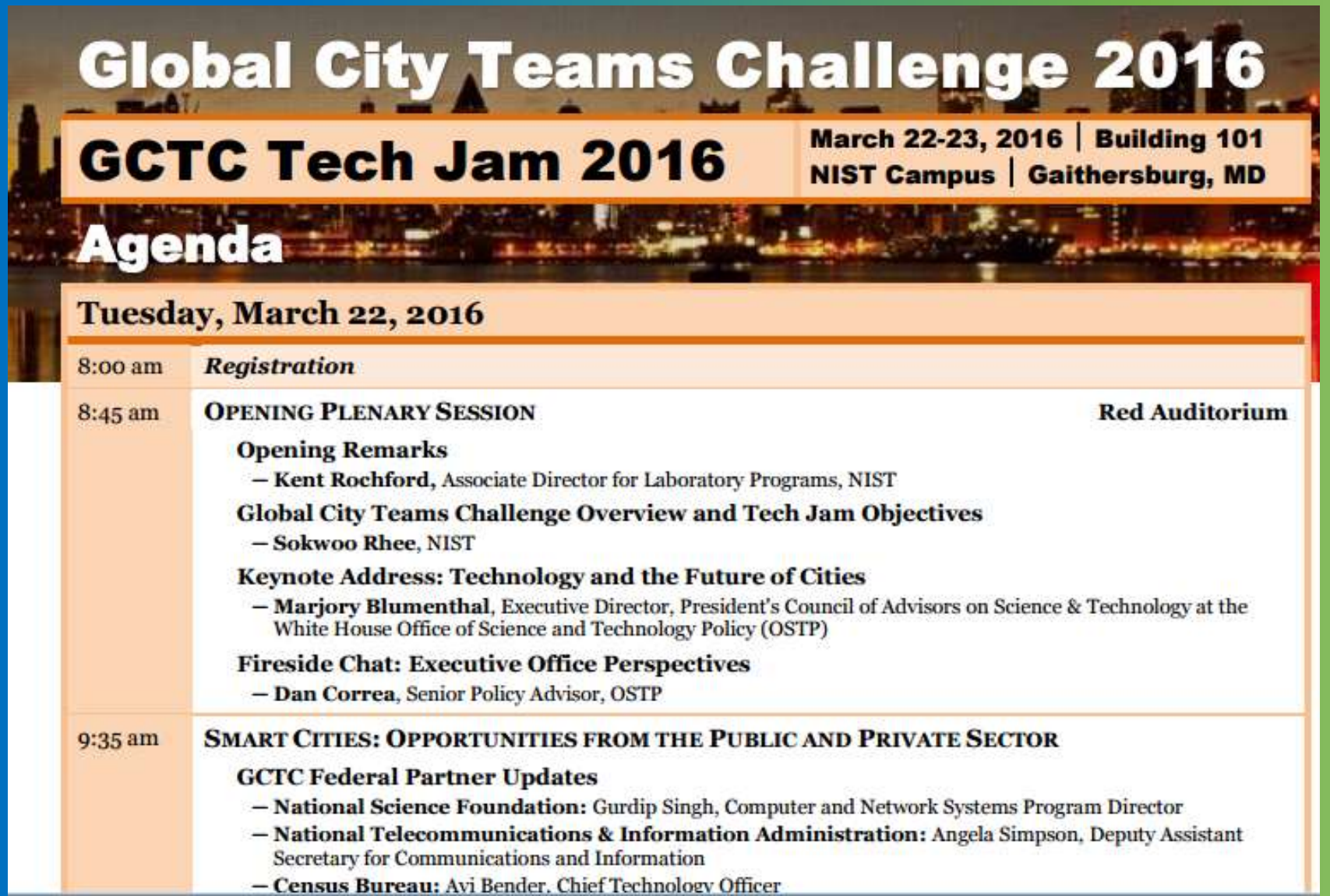
NIST National Institute of Standards and Technology U.S. Department of Commerce

NIST Website | About NIST | usnistgov on Github

International Technical Working Group on IoT-Enabled Smart City Framework

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.

NIST Global City Teams Challenge



Global City Teams Challenge 2016

GCTC Tech Jam 2016

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

Agenda

Tuesday, March 22, 2016

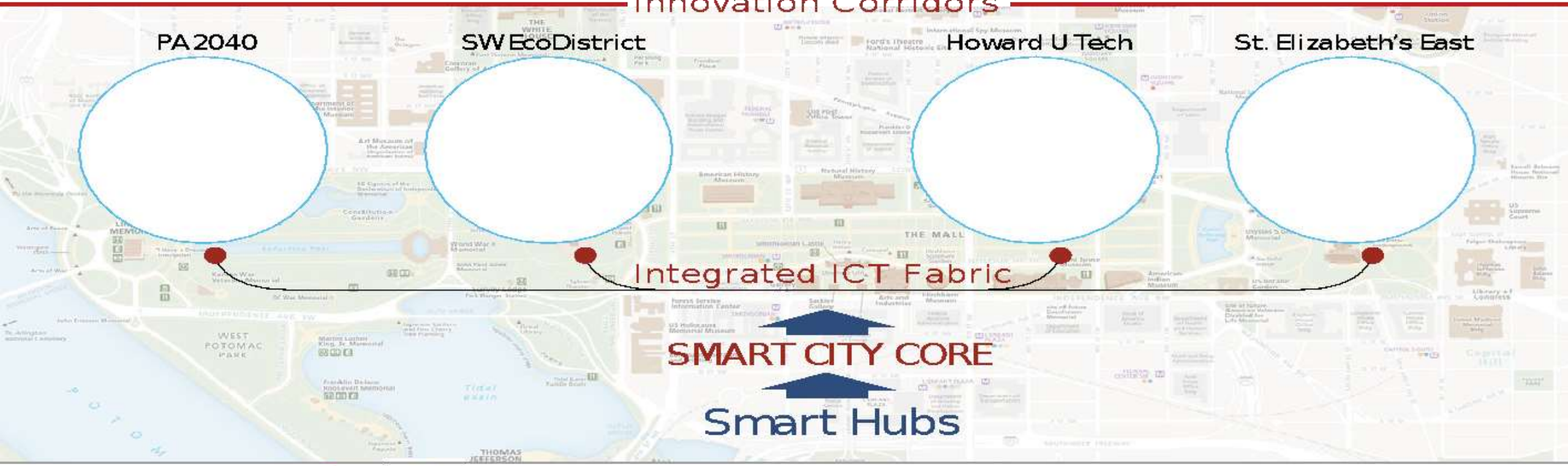
8:00 am	***Registration***
8:45 am	**OPENING PLENARY SESSION** — **Red Auditorium** **Opening Remarks** — **Kent Rochford,** Associate Director for Laboratory Programs, NIST **Global City Teams Challenge Overview and Tech Jam Objectives** — **Sokwoo Rhee**, NIST **Keynote Address: Technology and the 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:** Gurdip 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

SMARTER DC

Smarter DC Applications

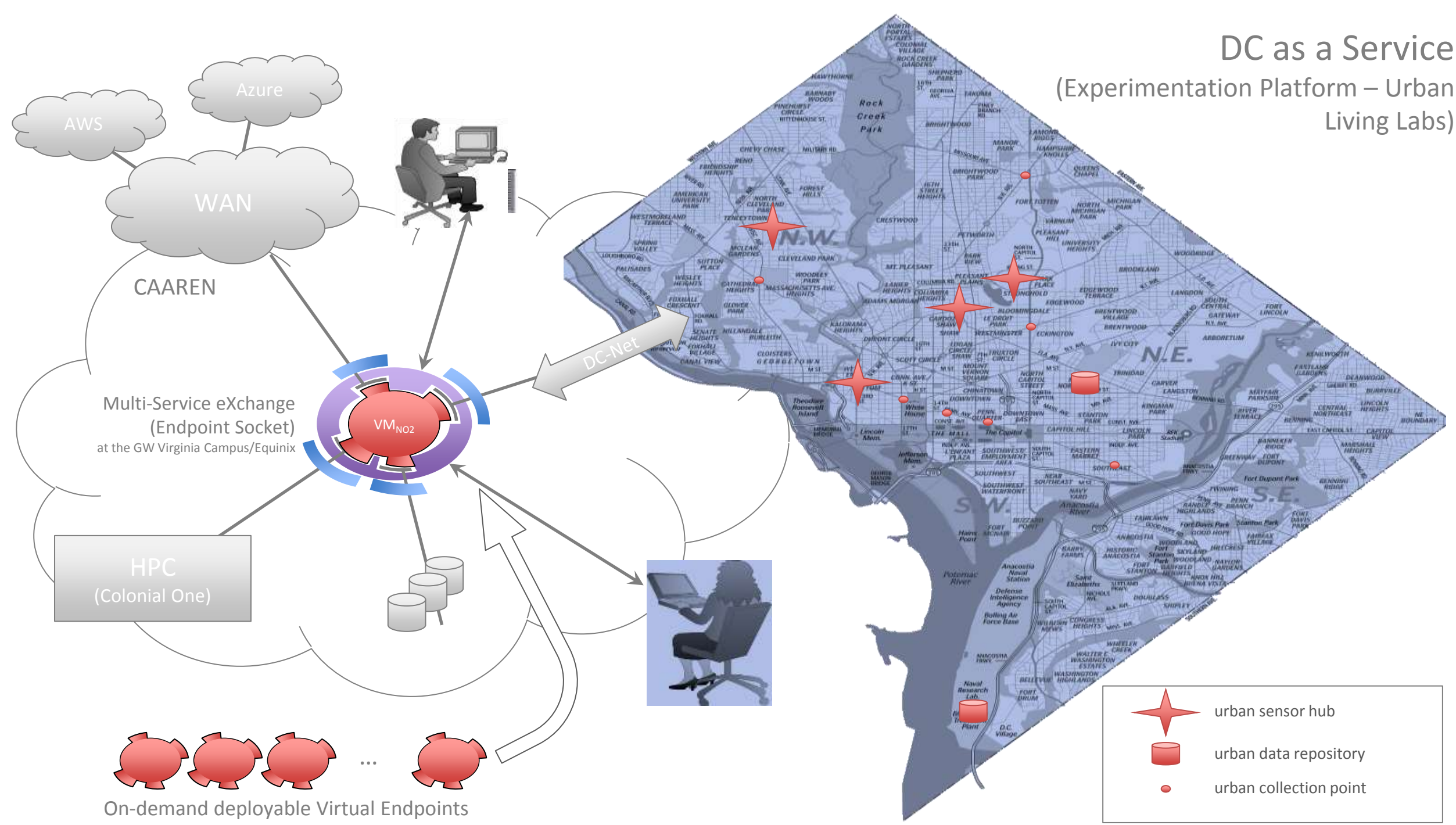
- Public WiFi
- Environmental Sensing
- Smart Lighting
- Kiosks
- Smart Parking

Innovation Corridors



DC as a Service

(Experimentation Platform – Urban Living Labs)



LIZ STINSON DESIGN 10.20.14 6:30 AM

NEW SMART STREET CORNERS THAT WILL ACT LIKE A FITBIT FOR THE CITY

A rendering of what a sensor node will look like.

Strategy Collaboration & Execution

BIM (and Technologies) Execution Planning

PENNSTATE

BIM EXECUTION PLANNING

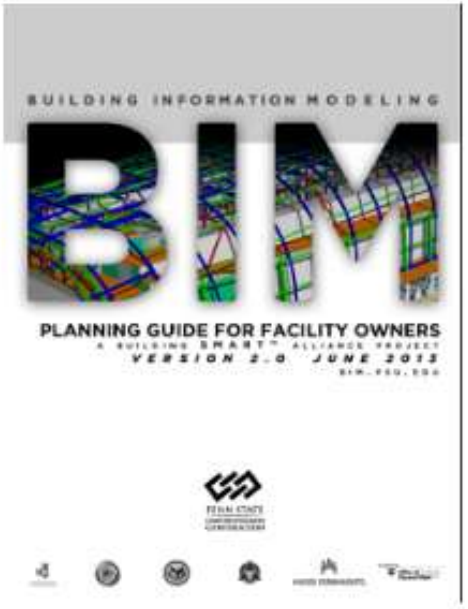
PENN STATE COMPUTER INTEGRATED CONSTRUCTION

Share 81

INTRODUCTION | Introduction Project Owner BIM Uses

- ANNOUNCEMENTS
- EVENTS
- RESOURCES
- FEEDBACK
- CIC Home
- AE Home
- Penn State OPP

Click to DOWNLOAD



Click to DOWNLOAD

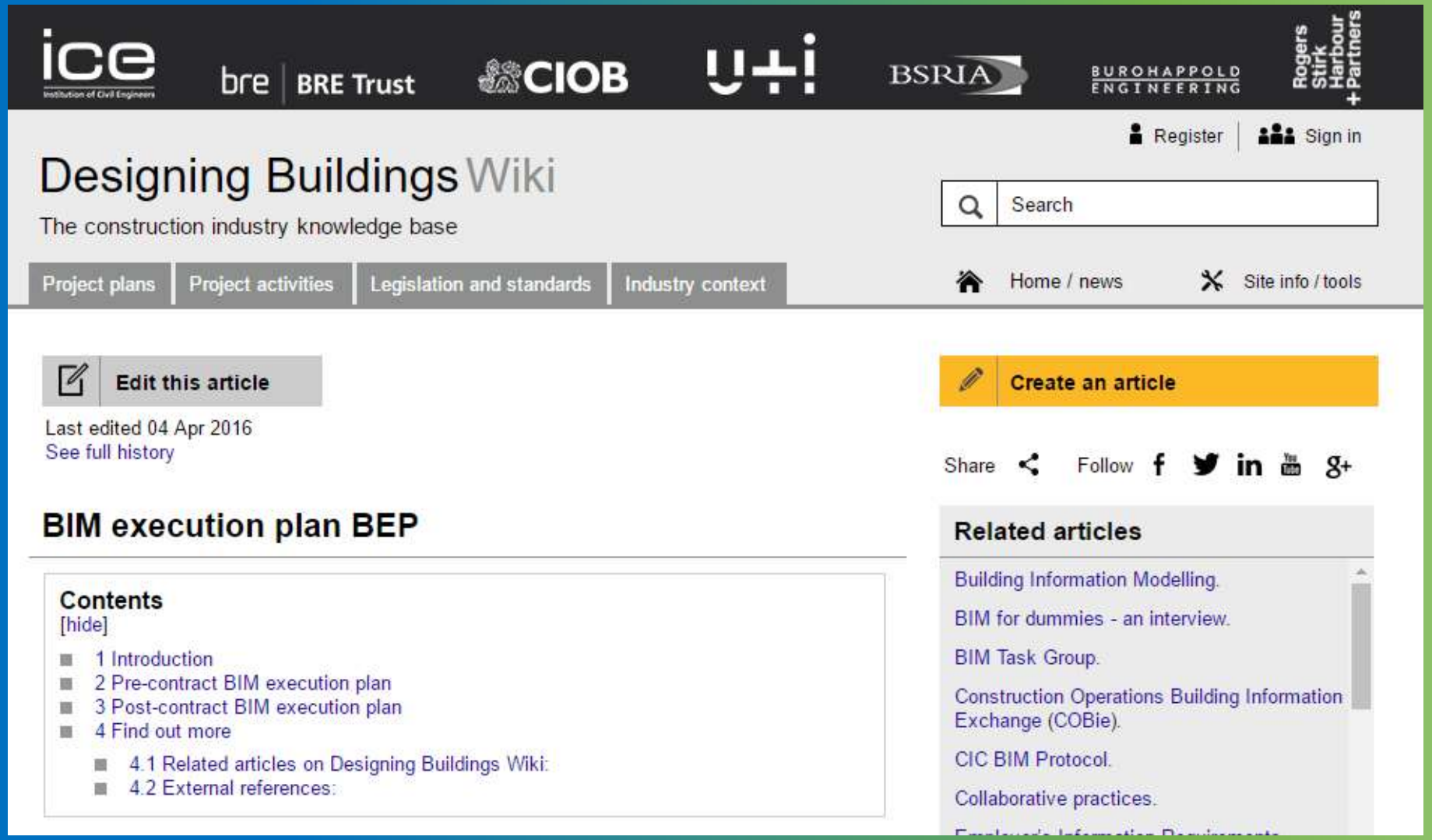
Announcements:

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

Version 2.0 of the BIM Planning Guide for Facility Owners Released June 2013.

Subscribe to BIM Planning's to recieve a

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
- Big Data and Analytics
- BIM
- CAFM
- Capturing Reality
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- CMMS
- Cybersecurity
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- Fog Computing
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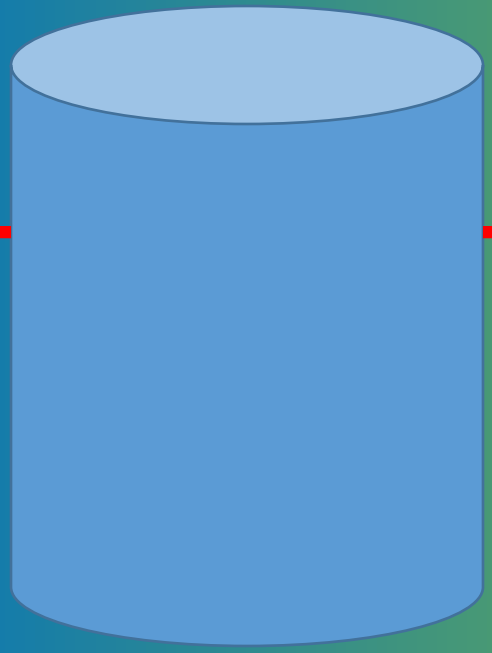

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- Pervasive Computing
- Sensors
- Simulation
- Social Networking and Media
- Specification Authoring
- Synchronization
- Virtual Reality
- Wearable Computing

Thank You

Stephen P Hagan FAIA
stephen.hagan@gmail.com 703 887 1886