

Evolving Use of BIM in K-12 Construction

JOERIS
General Contractors

Andy Gajbhiye
Chris Carruth
Scott Lee

Agenda

- Introduction
- Our BIM Experience
- BIM Requirements
- BIM Decision Criteria
- Take Aways

Chris Carruth

VP of Business Development



- 30 Years in Construction
- Executive Management Team
- Experience as Carpenter, Superintendent, Project Manager
- University of Houston - BS in Construction Management

JOERIS
General Contractors

Scott Lee

Project Executive

- 13 Years in Construction
- DFW Operations
- United States Military Academy - BS in Engineering Management
- Boston University - MBA

JOERIS
General Contractors



Anand Gajbhiye

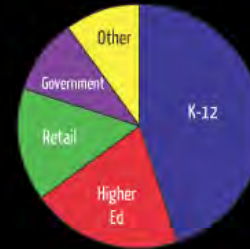
BIM Manager

- Responsible for over \$500M in BIM Preconstruction & Construction Projects
- Numerous Published Papers on BIM
- VJTI - Bachelor of Engineering, Civil Engineering
- Texas A&M University - Masters of Science in Construction Management

JOERIS
General Contractors

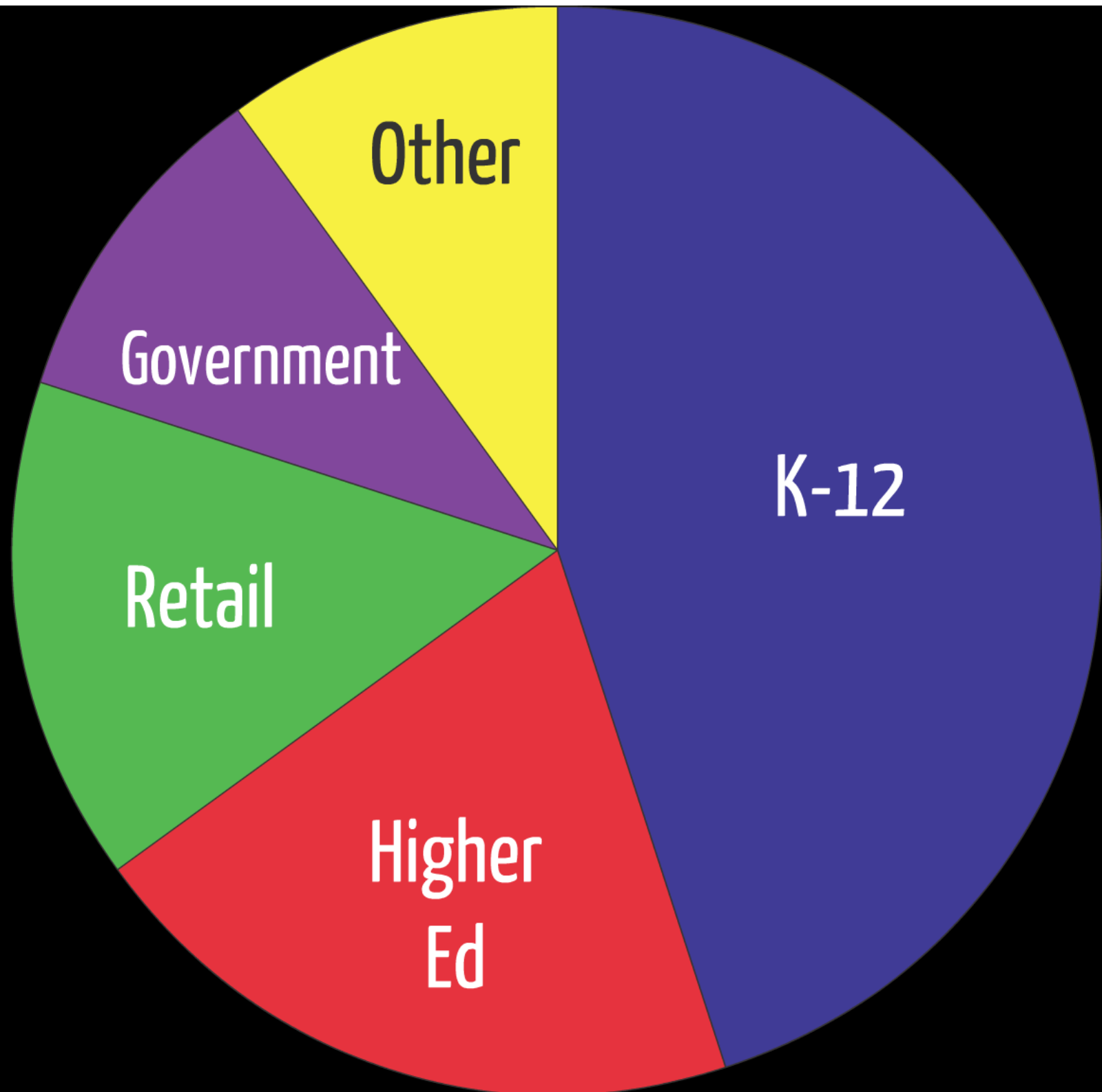
Founded
1967

265 employees



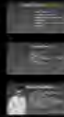
JOERIS

General Contractors



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[Over 100 K-12 Campuses]
(\$2Billion in K-12 Construction)

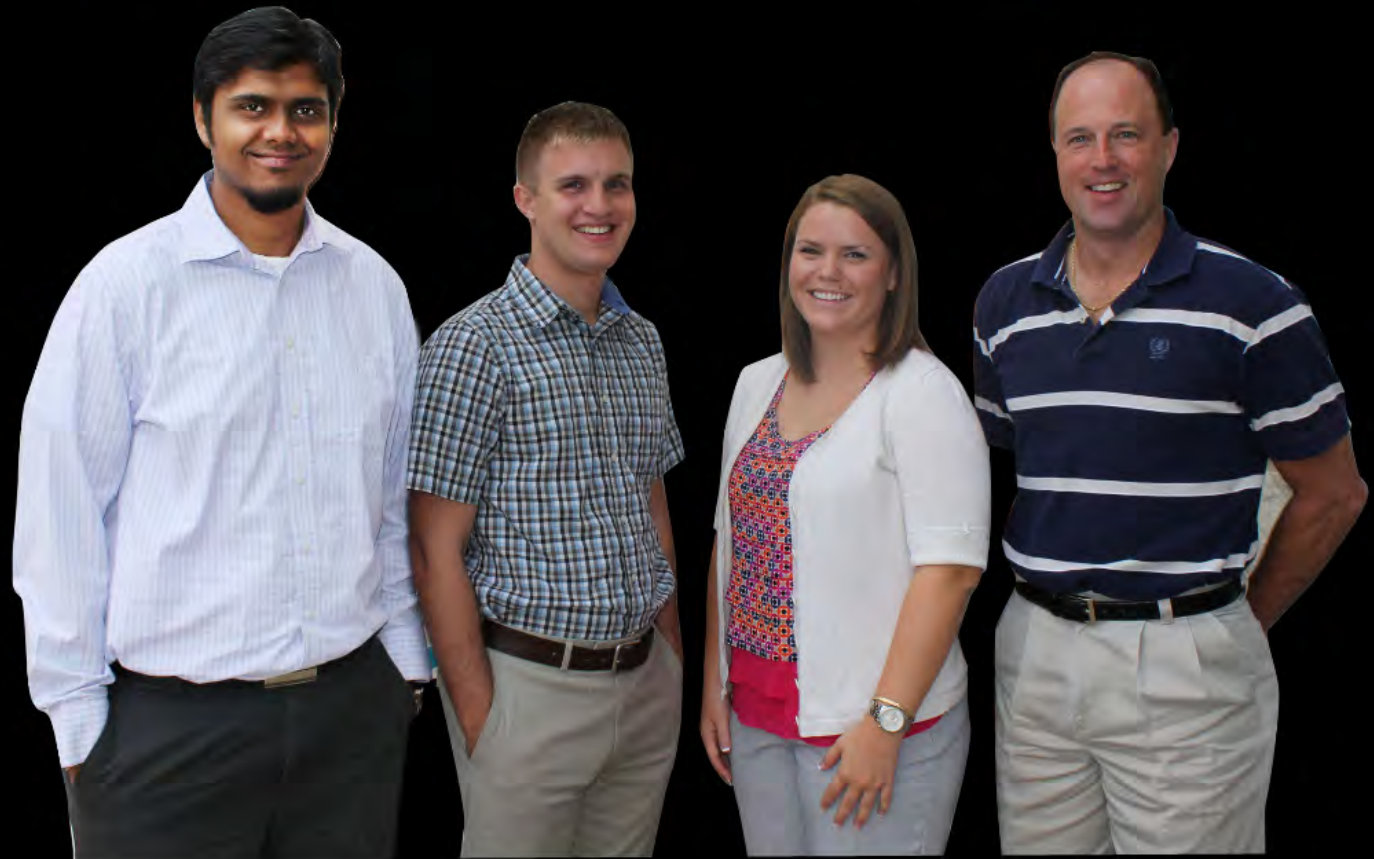
Our BIM story





Our BIM story

2013	\$400M (projected)
2012	\$198M
2011	\$111M
2010	\$28M



LYNDSY JOHNSON | SABI



Digital Dimensions

BY DONNA J. TUTTLE

During the last decade, Building Information Modeling (BIM) has become standard practice in the construction industry.

BIM is a process of collecting data to create 3D models of construction projects.

Unlike a 2D model, BIM allows architects and contractors to better visualize together

maintain their projects.

The trend still is emerging, but locally, Texas A&M University-San Antonio is leading the way. Its physical plant team is using BIM data to create digital models of its new facilities.

The goal is to easily pinpoint repairs, monitor systems and link to PDFs of warranties and manuals.

In this week's Commercial Real Es-

Chromalloy downsizing may be S.A. plant's gain

Aerospace firm closing four sites, officials confirm

BY W. SCOTT BAILEY AND MIKE W. THOMAS

The aerospace industry delivers a \$5 billion economic injection for San Antonio annually, and local leaders believe there is an opportunity to grow that sector further.

Some of that expansion could come at other cities' expense.

Chromalloy has confirmed that it plans to shutter facilities in Gardena, Calif.; Midwest City, Okla.; Nuevo Laredo, Mexico; and Tilburg, Holland. Those closures will impact roughly 530 employees, most of them skilled aerospace workers. The Florida-based aerospace company will retain operations in San Antonio, which could receive more work as a result of the consolidation, according to industry experts.

Chromalloy maintains and repairs tur-

bine airfoils and other critical engine components used by commercial aerospace companies, the military and the energy industry. The company employs more than 4,000 workers globally, including some 250 in the Alamo City.

Chromalloy officials expect that the consolidation will allow the company to be more competitive. They would not say if the workforce in San Antonio is expected to change as a result of the closures.

Like a number of local officials, Bexar County Economic Development Executive Director David Marquez was not aware of Chromalloy's consolidation plans. That's not unusual as companies often try to keep such downsizing plans a secret as long as possible.

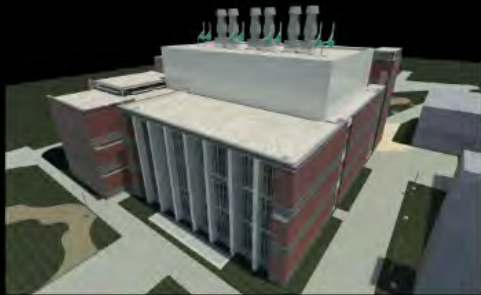
See CHROMALLOY, Page 3



Chromalloy

- HQ:** Palm Beach Gardens, Fla.
- Services:** Maintains and repairs turbine airfoils and other engine components by commercial aerospace companies and the U.S. military
- San Antonio facilities:** Port San Antonio
- Local employees:** About 250
- Planned plant closures:**
 - Gardena, Calif.
 - Midwest City, Okla.
 - Nuevo Laredo, Mexico
 - Tilburg, Holland
- Website:** www.chromalloy.com

BUILDING INFORMATION MODEL



(noun)

VS

BUILDING INFORMATION MODELING



(verb)

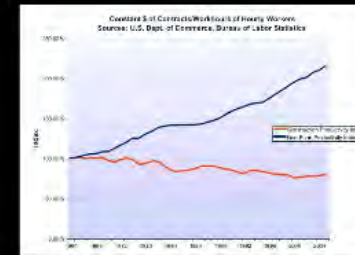
DIGITAL INFORMATION MODEL



Why BIM?

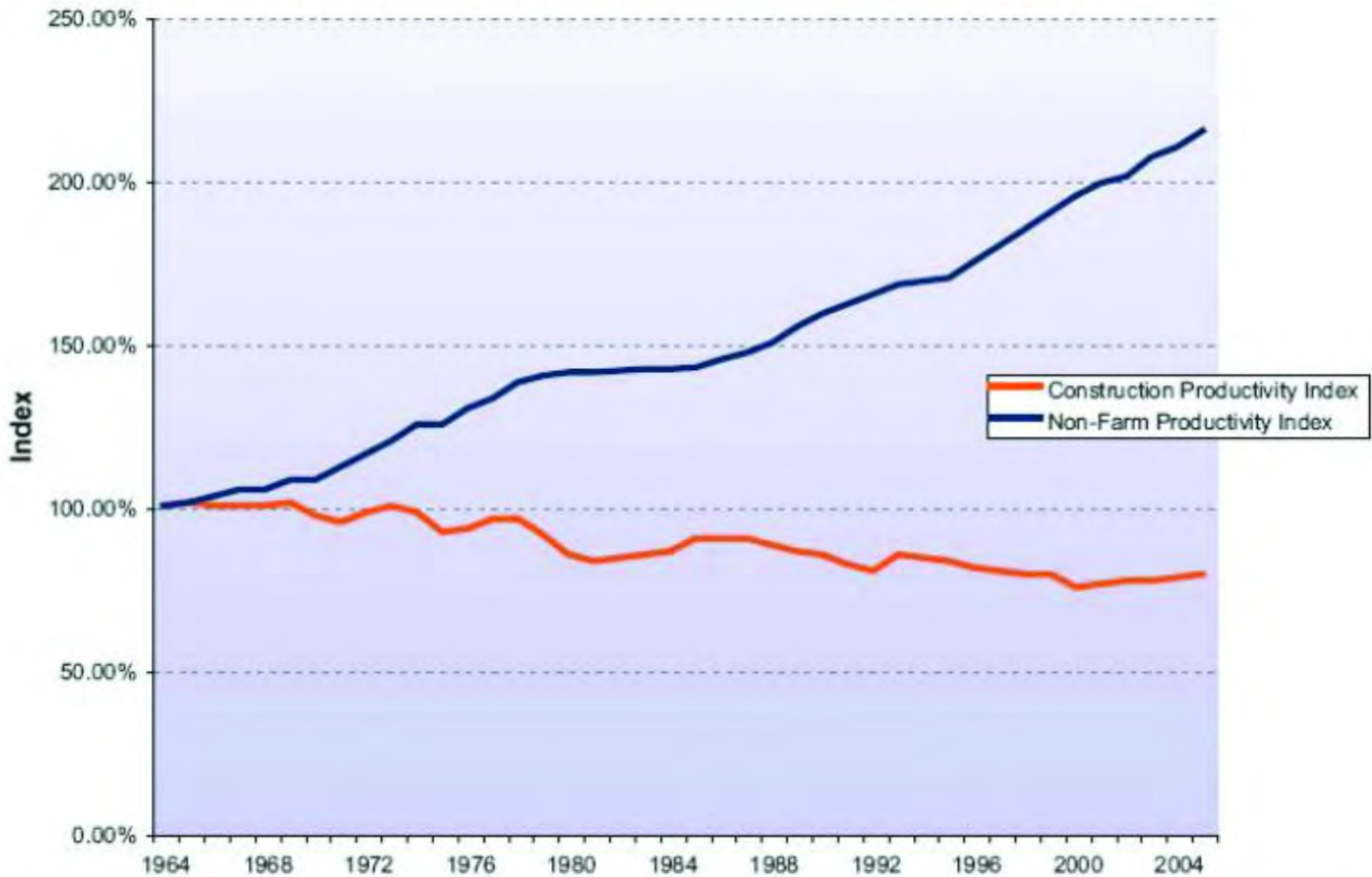
Trends: Earlier vs. Today

- Project Characteristics - More Complex, Innovative Architecture
- Lack of Interoperability = \$15 billion losses annually
- Labor Productivity



■ ■ ■ Analogy ■ ■ ■

Constant \$ of Contracts/Workhours of Hourly Workers
Sources: U.S. Dept. of Commerce, Bureau of Labor Statistics

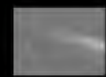




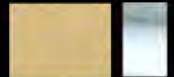
vs



Analogy



vs



Nabokov

Rare

PG

3476

ML1

L8

1955a

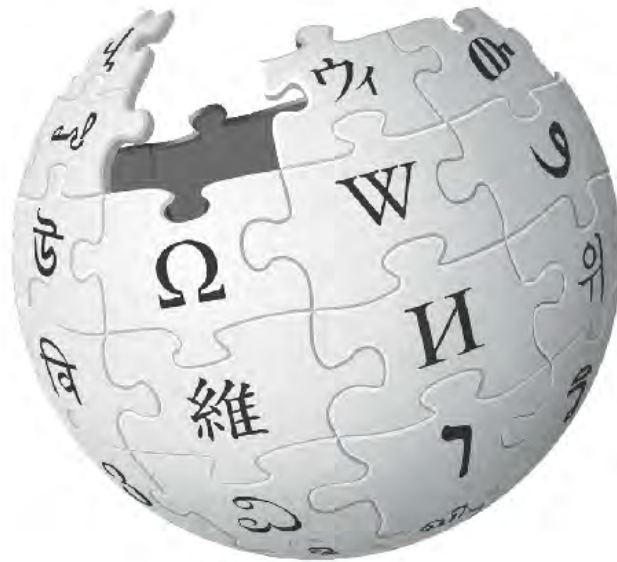
Nabokov, Vladimir Vladimirovich, 1899-

Lolita. New York, Putnam, c1955,

319 p. 22cm.

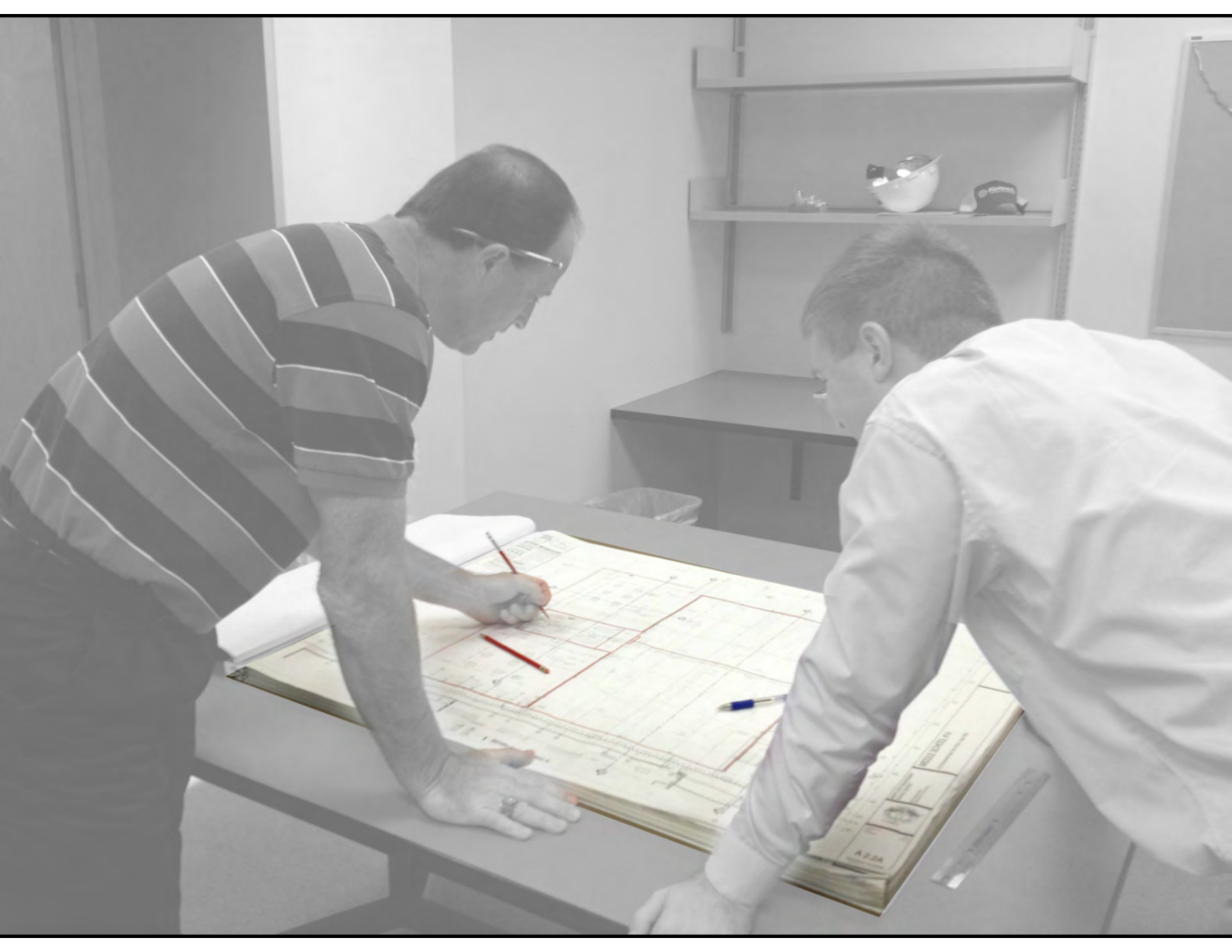
"On a book entitled Lolita," by Nabokov:
p. 313-319.

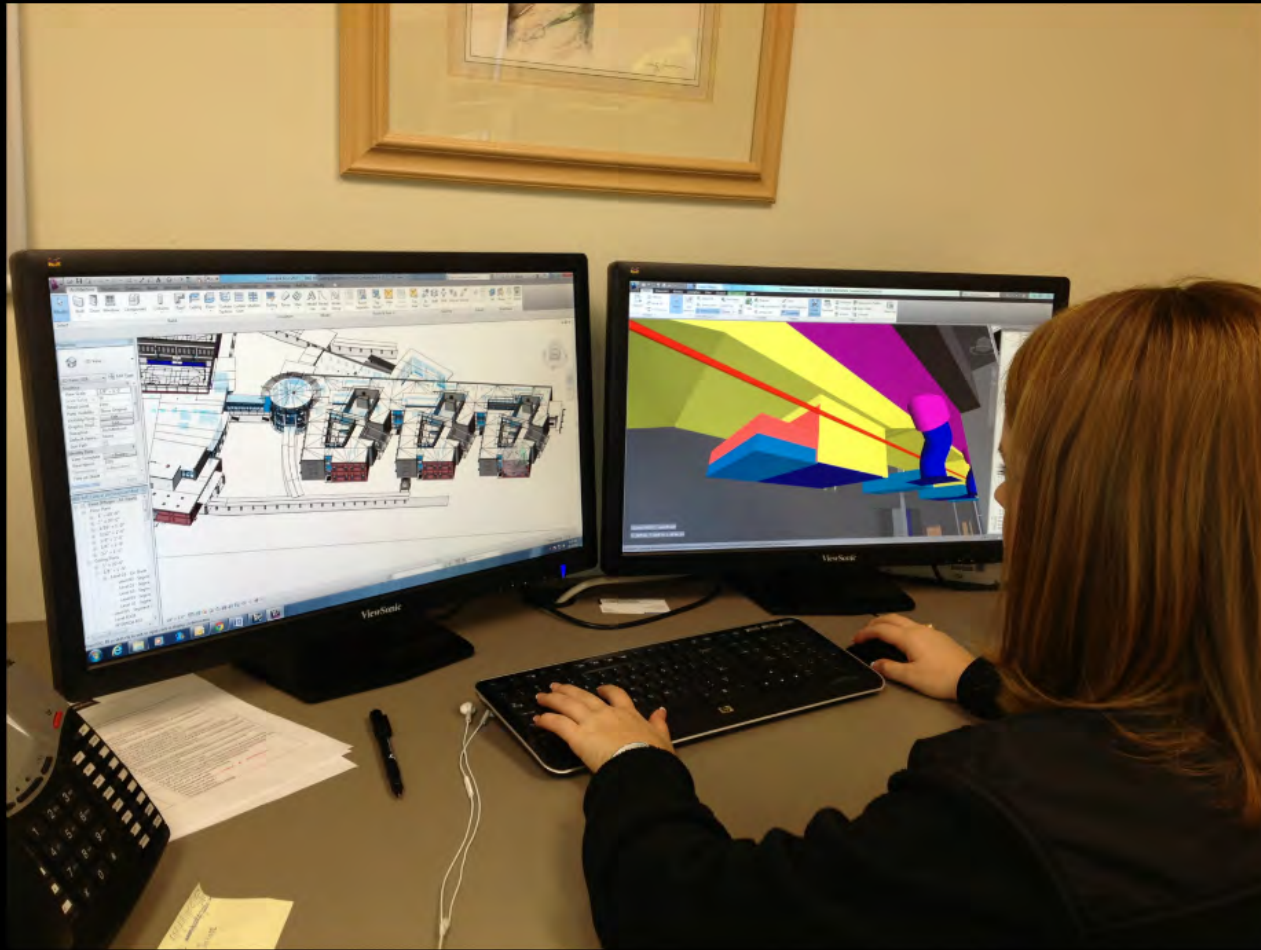
Google



WIKIPEDIA

YAHOO!



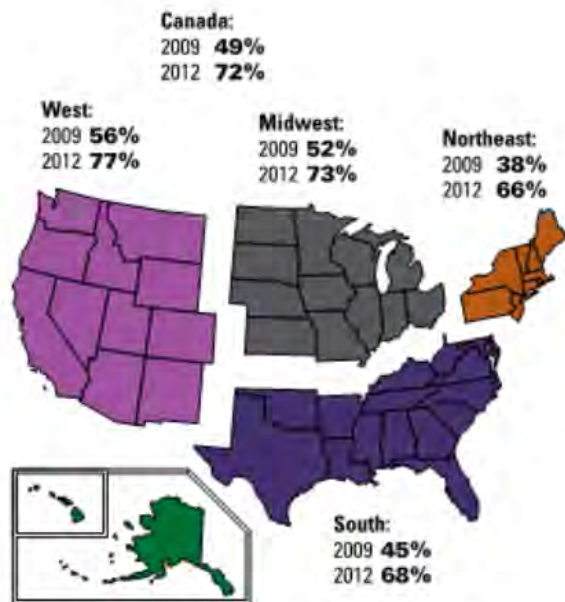


Levels of BIM Adoption in North America



BIM Use in North America

Source: McGraw Hill Construction, 2012

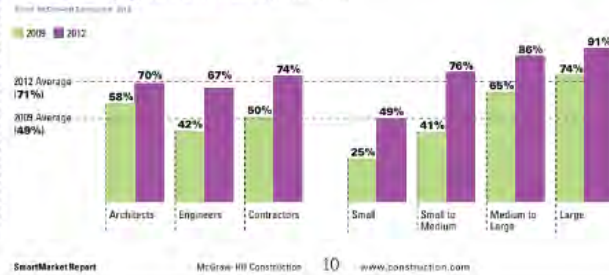


ROI

Almost two thirds (62%) of all BIM users' perceive positive ROI, although not evenly across firm types or BIM engagement levels (a weighted metric of implementation, skill and experience levels developed for this *SmartMarket Report*).

- 74% of the contractors report a positive ROI compared to only 37% of engineers.
- ROI correlates strongly with BIM engagement level, rewarding companies with higher skill, experience and implementation levels.

BIM Adoption by Type and Size of Firm (2009 and 2012)



Importance of BIM Capability for Project Team Selection

Source: McGraw Hill Construction, 2012

Importance of BIM Capability for Project Team Selection	All BIM Users
We Require Companies to be Experienced in BIM.	28%
We Encourage BIM Expertise, But Do Not Require It.	52%
BIM Expertise Does Not Affect Our Decisions.	19%



A study by J.C. Cannistraro of 408 projects valued at \$559 million shows how, in the big picture, BIM saves money as the team gets more collaborative.

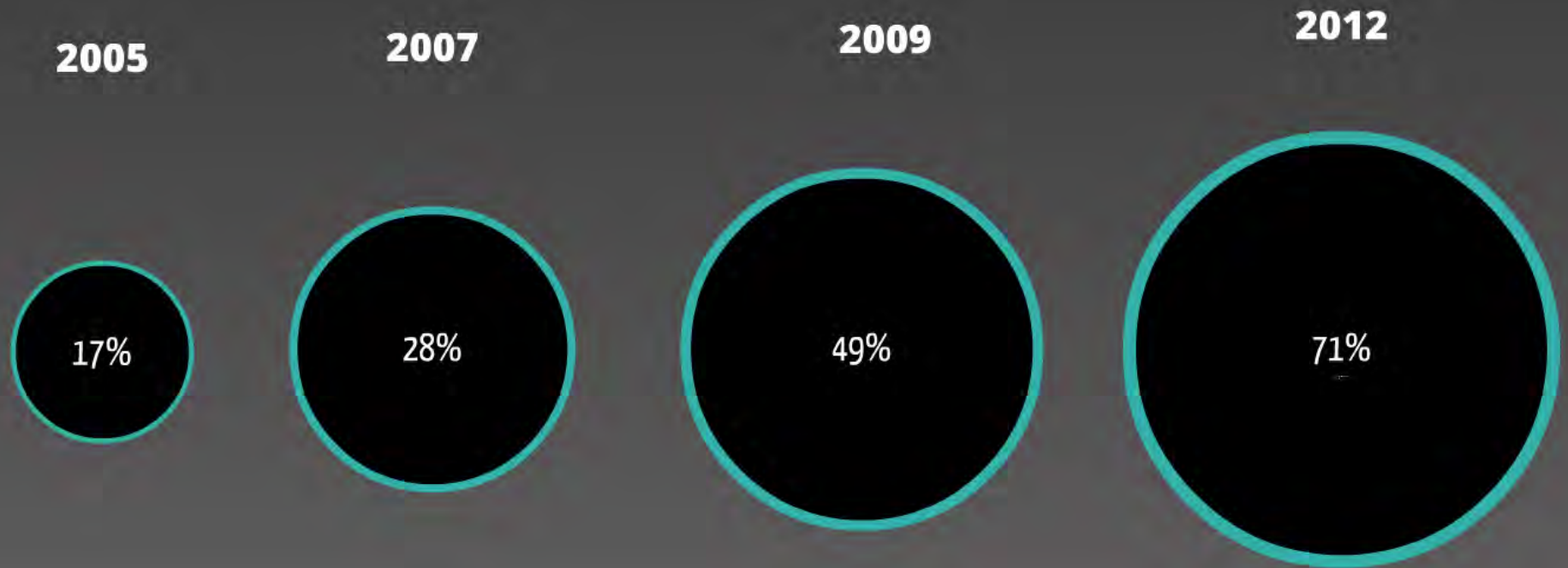
STATS

2012 McGraw Hill Smart Market BIM Report

STATS

2012 McGraw Hill Smart Market BIM Report

Levels of BIM Adoption in North America



BIM Use in North America

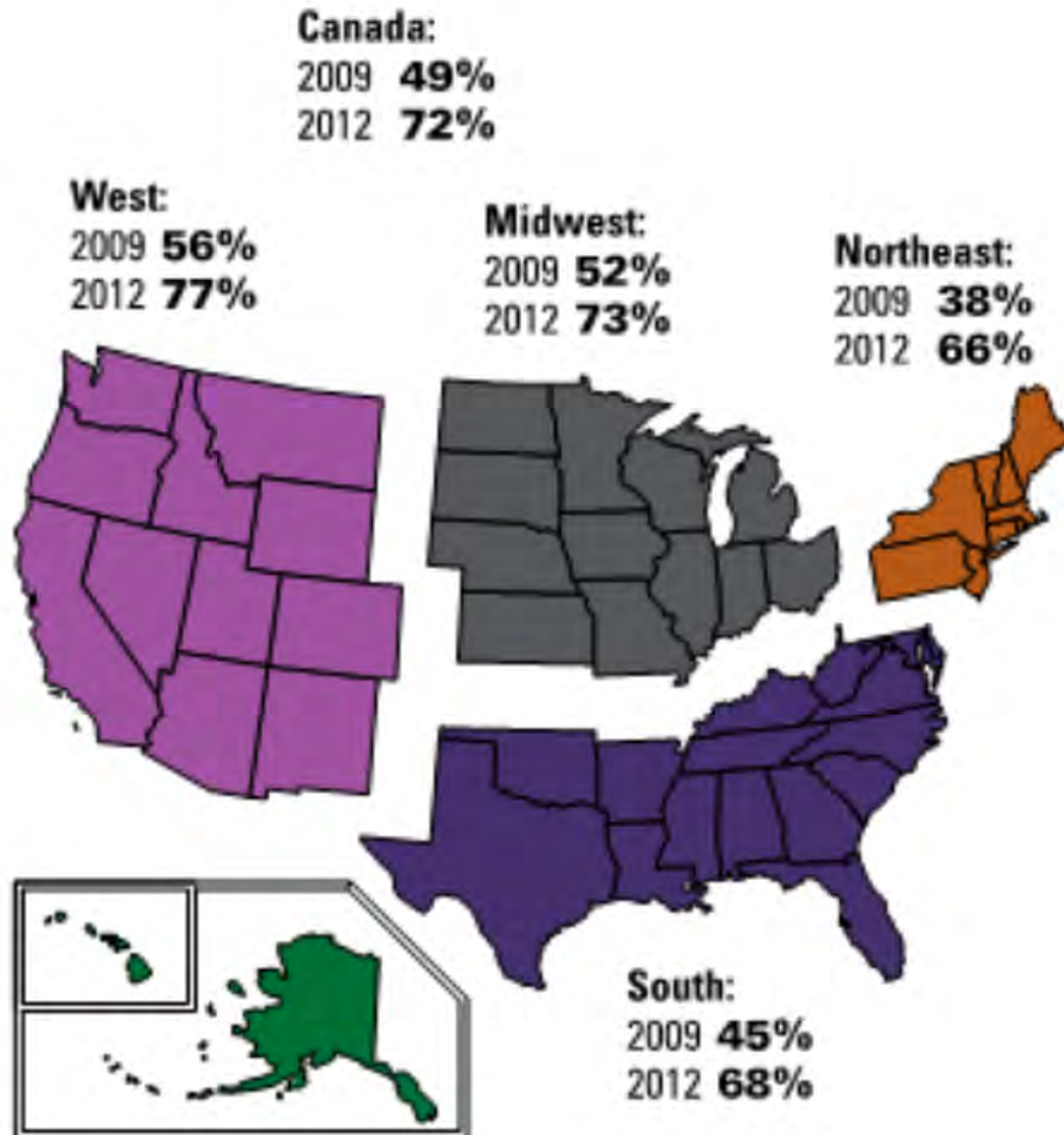
Source: McGraw-Hill Construction, 2012

74% General Contractor

70% A/E

BIM Use in North America

Source: McGraw-Hill Construction, 2012



BIM Adoption by Ty

Source: McGraw-Hill Construction, 2012

2009 2012

2012 Average (71%) 58%

2009 Average (49%)

Archit

SmartMarket Report

Importance of Project Team

Source: McGraw-Hill C

Importance of

We Require Co

We Encourage

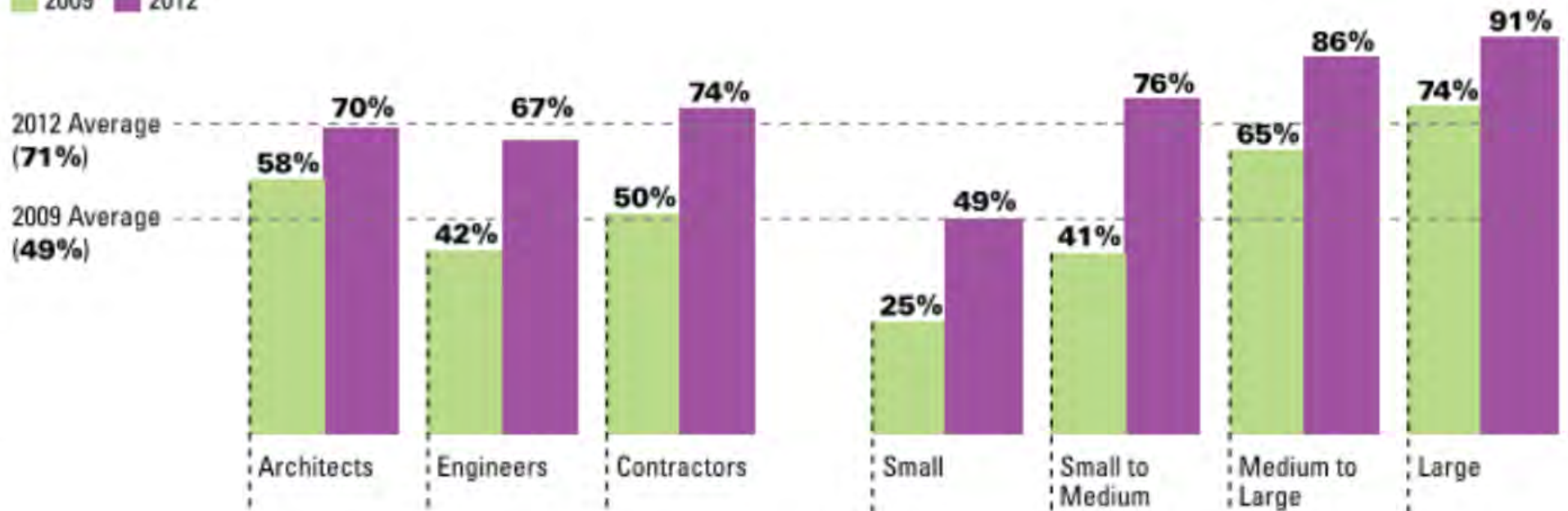
BIM Expertise

rewarding companies with higher skill, experience and implementation levels.

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2009 2012



2012

71%

ROI

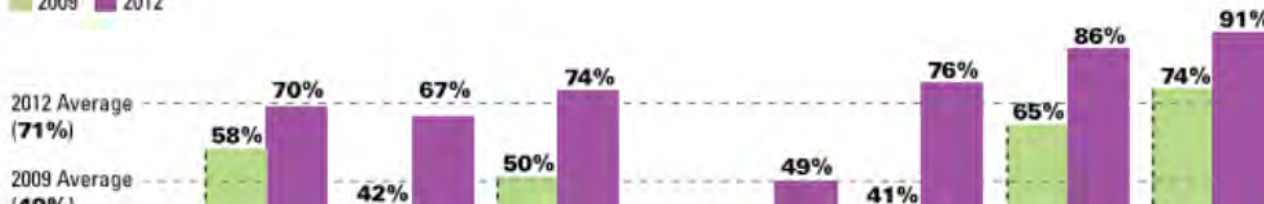
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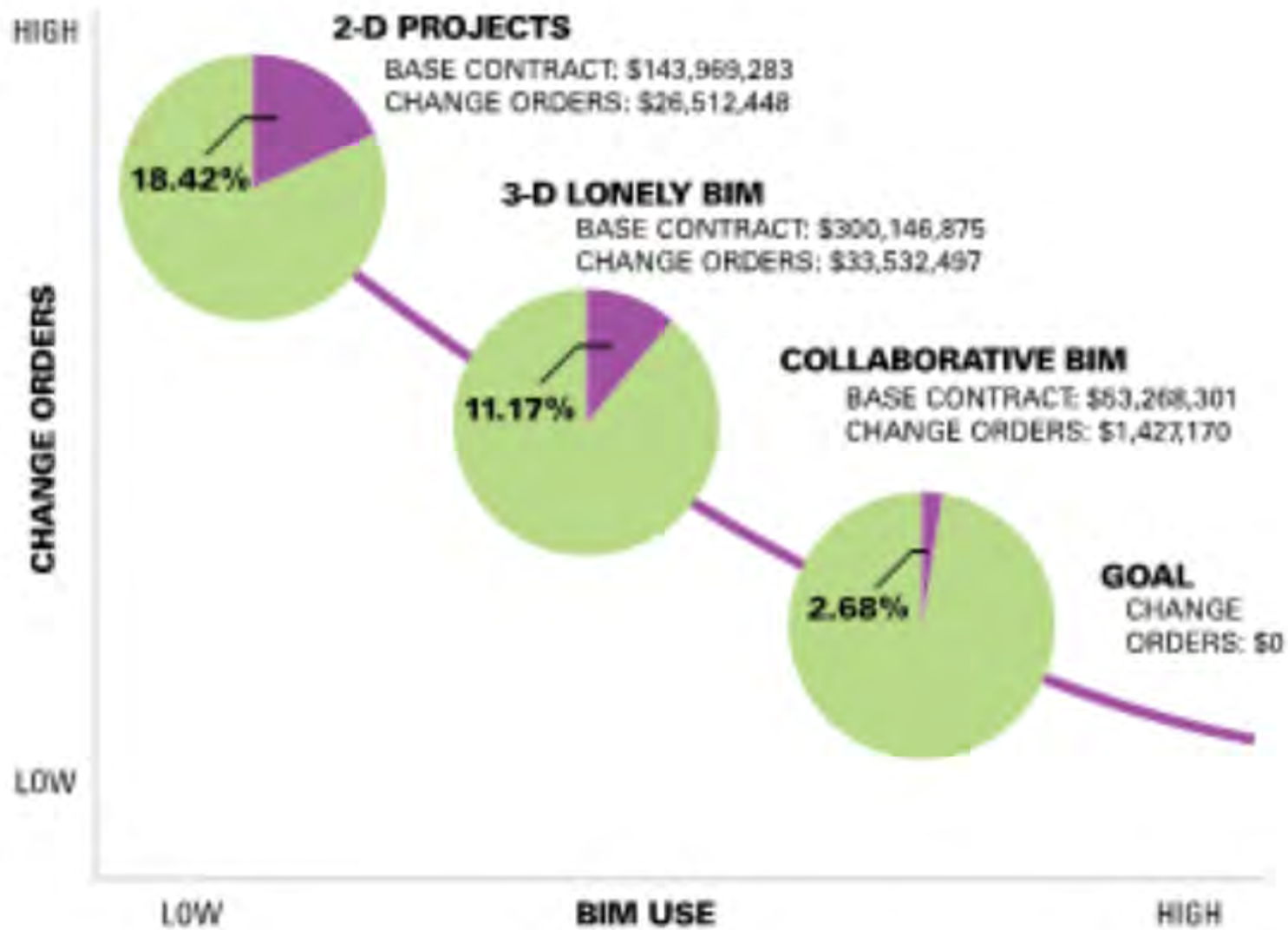
2009 2012



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Joeris BIM Experience

- Construction Process: *On Time, On Budget, Collaborative Process*
- Facilities Management Process: *Effective O&M, Save \$ in Life Cycle Costs*

Our K-12 BIM Experience

Preconstruction

- Clash Detection & Coordination
- Phasing Simulation
- Model Based Cost Estimation
- Value Engineering
- Site Analysis
- Constructability

Construction

- Shop Modeling
- Subcontractor Training
- Clash Detection and Coordination
- Construction Simulation
- Virtual Mock-ups

Facilities Management

- As-Built Models
- Submittal Loaded Models
- Laser Scanning
- Bar Coding



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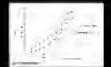
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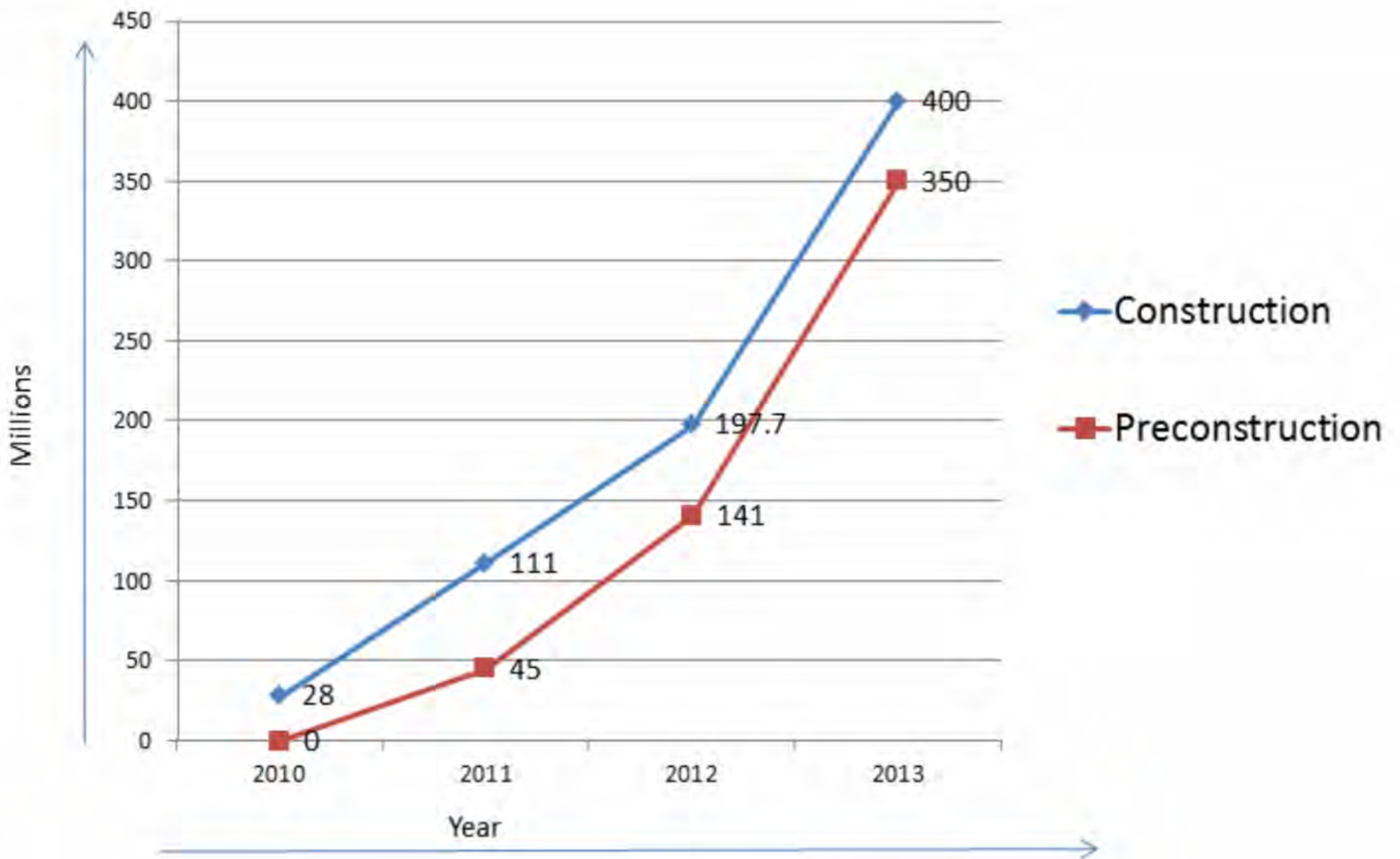
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Joeris BIM Growth

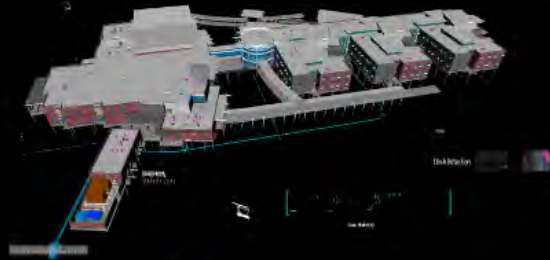
Case Studies

(Our BIM Experience)

BIM for Construction

NEISD MS#14

- Budget: \$56M
- Schedule: 24 months



Results

Schedule Impact: -1.18% (90 days) schedule savings
 Costs Avoided: \$184,500 (0.33%)
 RTI Savings: 6%

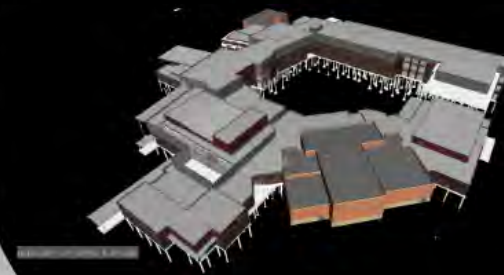
On a total \$22 project, cost savings at construct key stage by risk determination (BIM) is 0.75%



BIM for Preconstruction

SAISD Highlands

- Budget: \$56M
- Schedule: 40 months



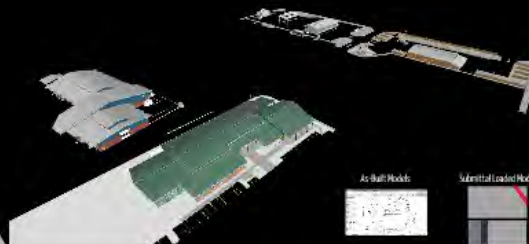
Results

Cost Savings: 2%
 Increase in Accuracy: 15%

BIM for Facilities Management

San Antonio Northwest Service Center

- Budget: \$16M
- Schedule: 18 months



As-Built Models



Submittal Loaded Models



Results

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 Increase in Accuracy: 15%

BIM for Construction

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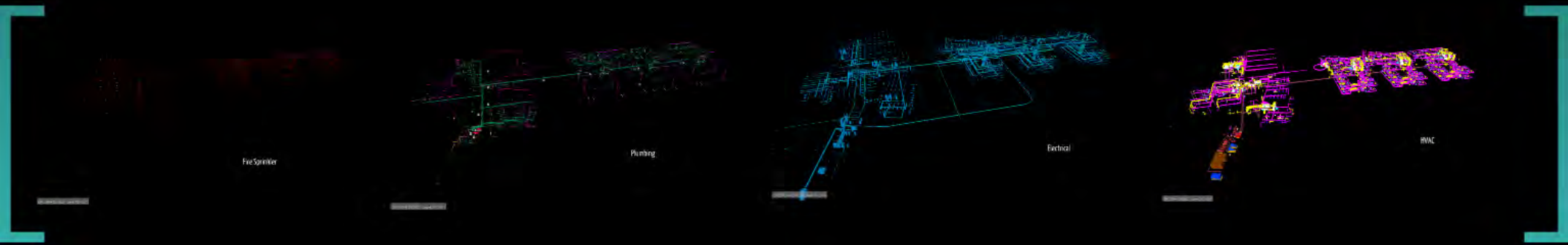
Results

Schedule Impact: 4.16% (30 days) schedule savings
Costs Avoided: \$180,500 (0.32%)
RFI Savings: 63

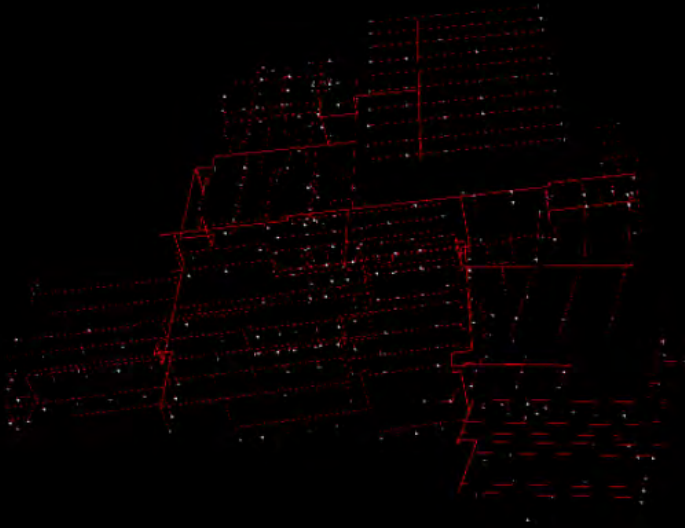


On a typical K-12 project, cost savings at construction stage for clash detection using BIM is 0.32%-0.75%





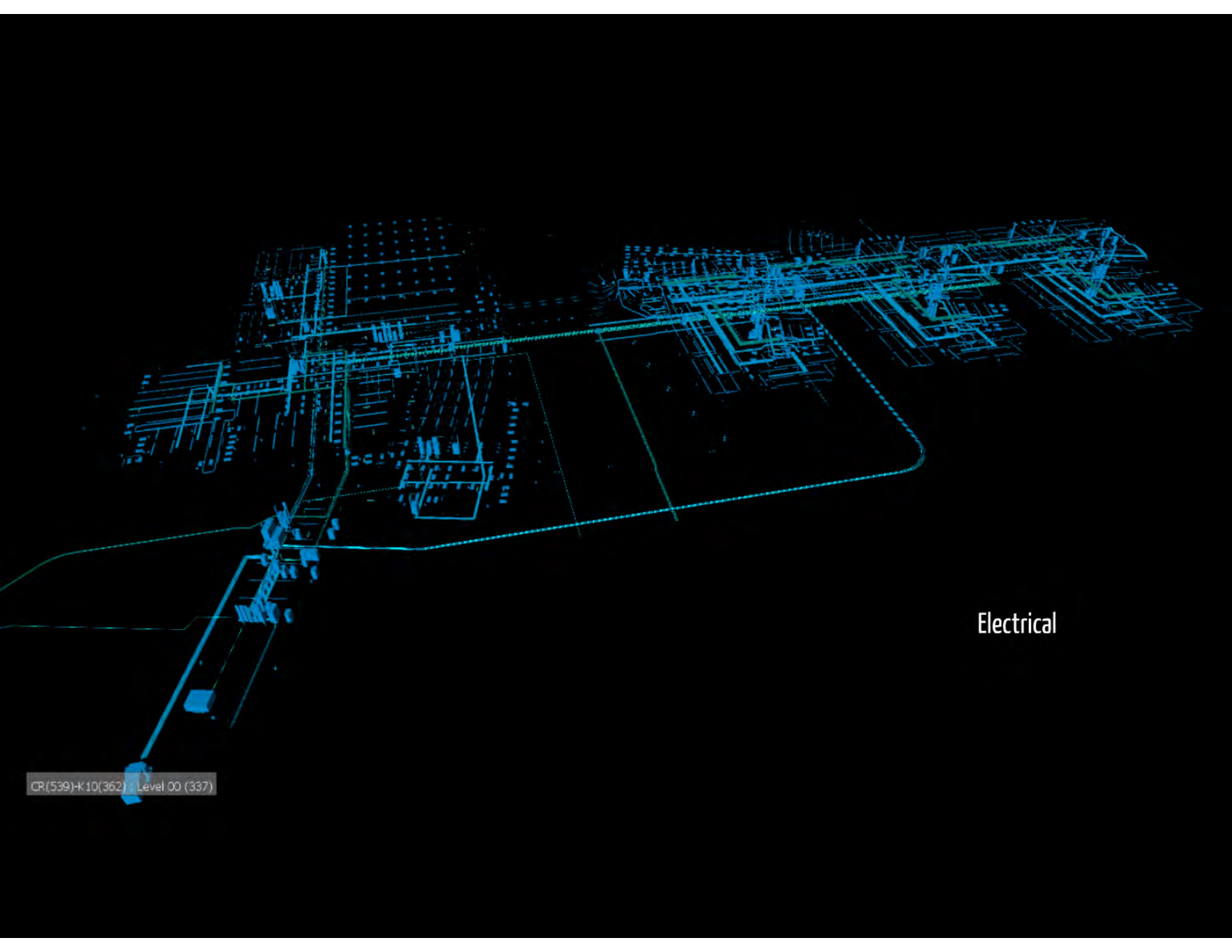
Shop Modeling



Fire Sprinkler

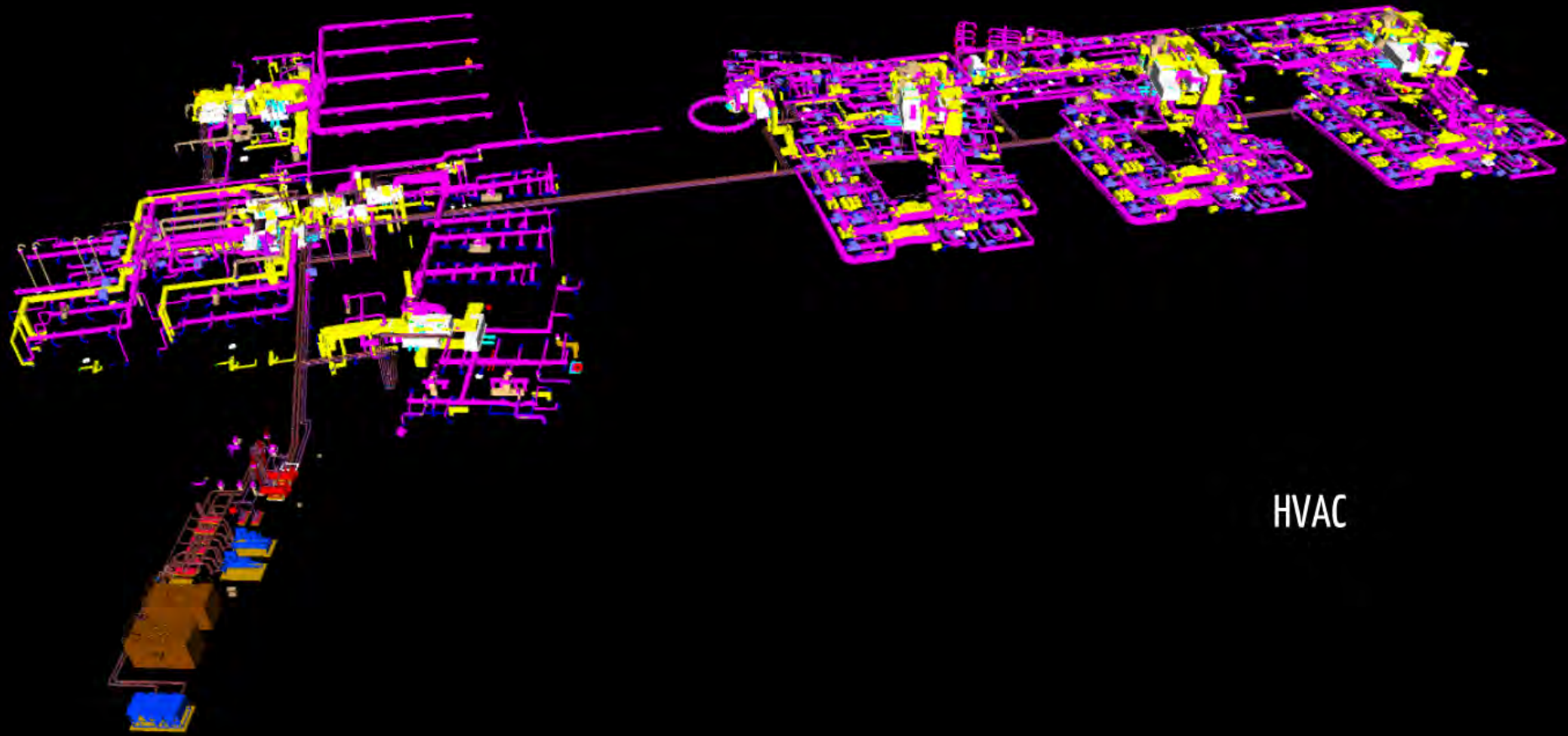


Plumbing



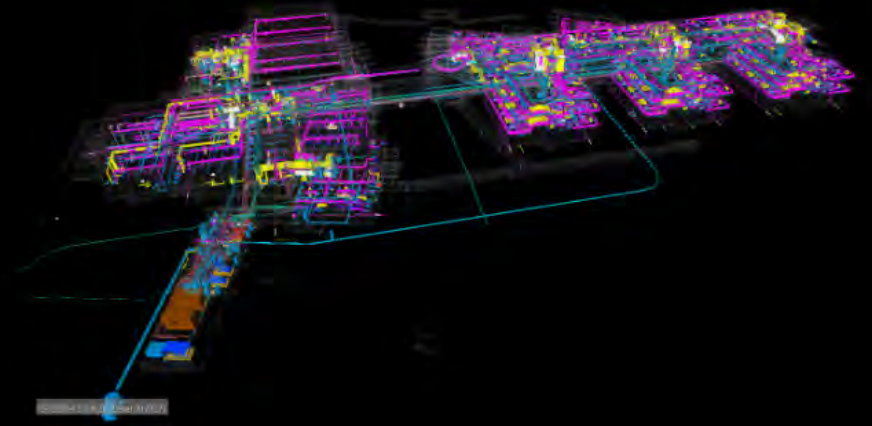
Electrical

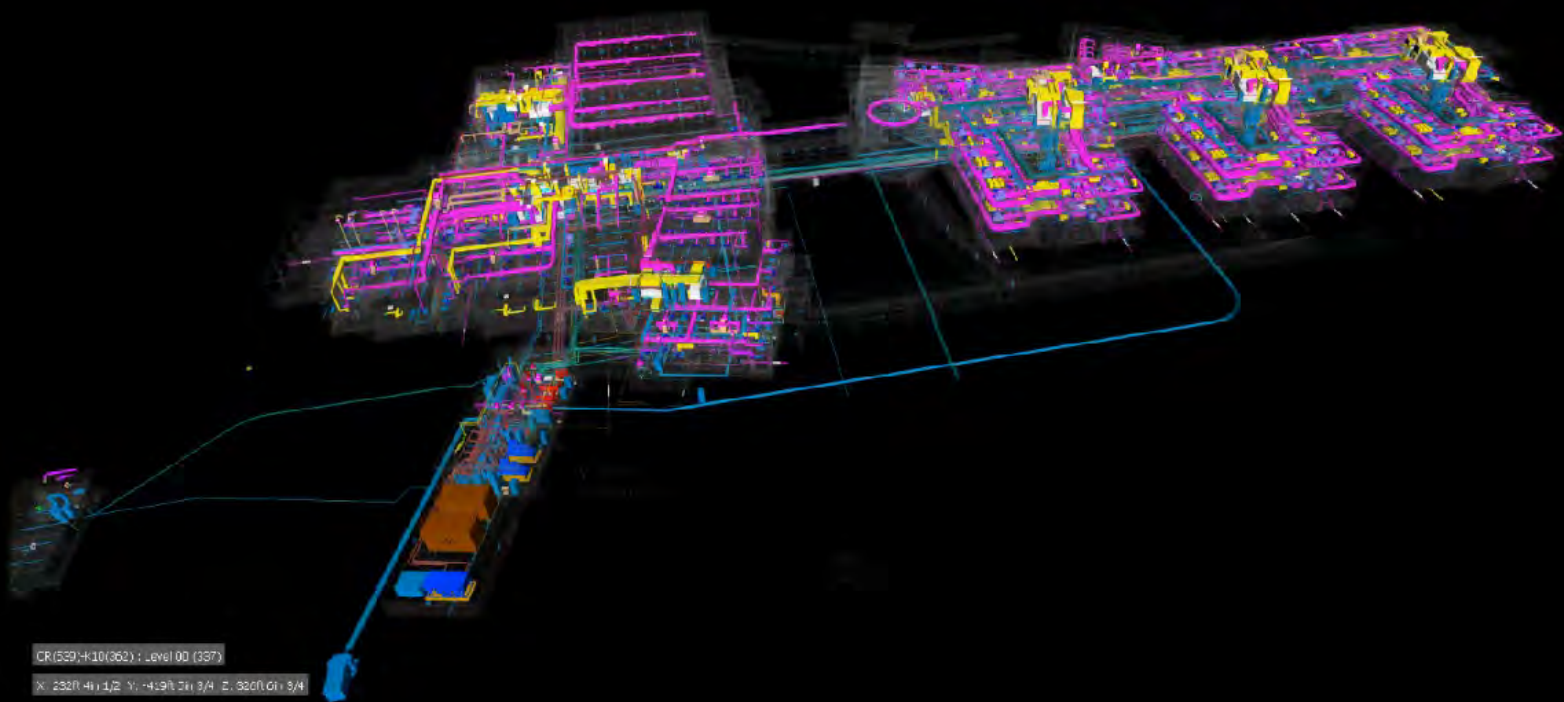
CR(539)-K10(362) : Level 00 (337)



HVAC

Clash Detection





CR(539-H-10(362)) : Level 00 (397)

X: 2820.4112 Y: -4490.5419 Z: 9207.0115/4

iPads

Results

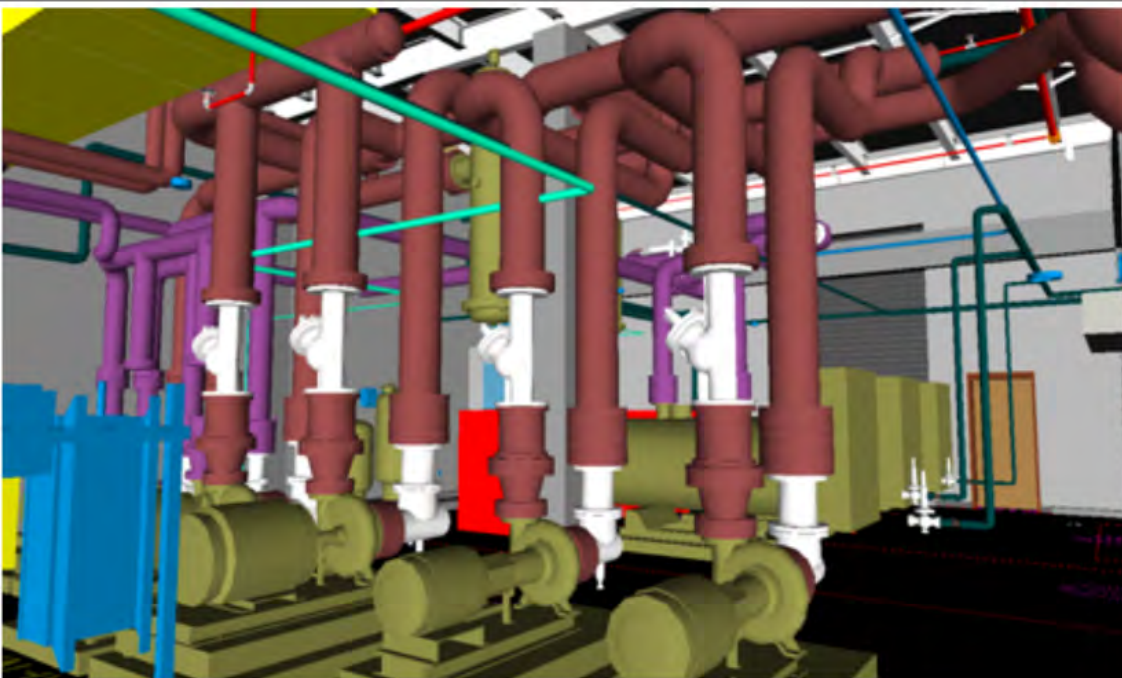
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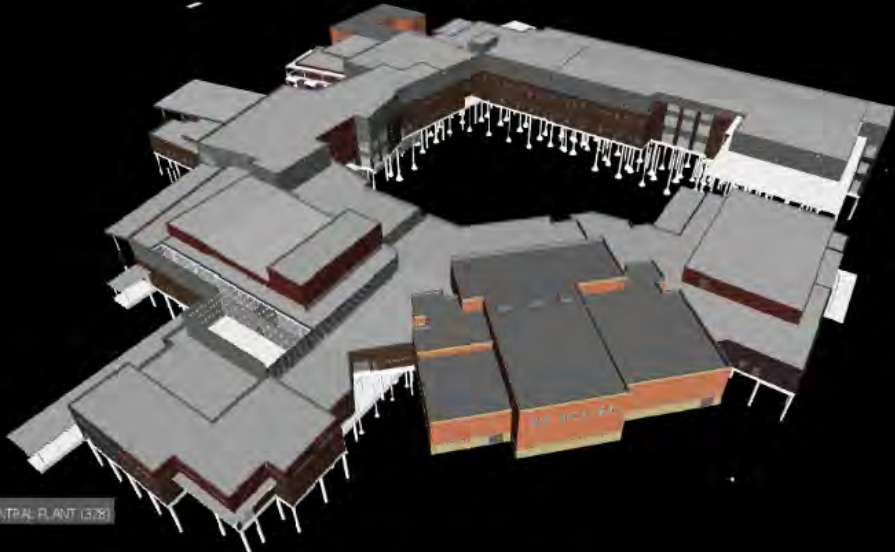
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BIM for Preconstruction

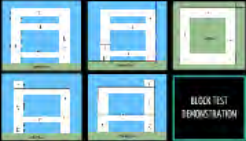
SAISD Highlands

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Model-Based Cost Estimation

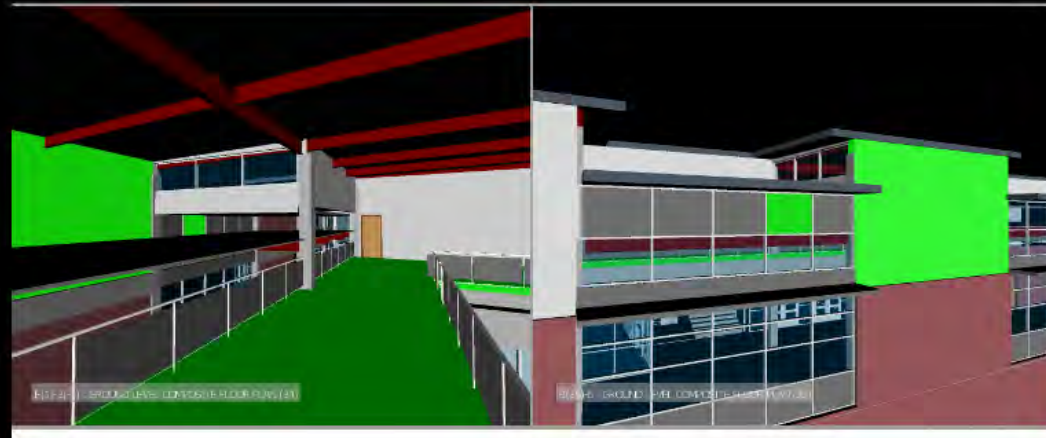
The screenshot displays a software interface for model-based cost estimation. The central 3D model shows a building with red highlights indicating selected components. The interface includes several panels:

- Building Sections:** A tree view on the left showing 'Default (2418)' and 'New Construction-Walls Only (2418)'.
- Component Types:** A list on the right with checkboxes for various architectural elements like 'Exterior Walls Concrete (0)', 'Interior Walls Masonry (0)', etc.
- Managed Quantities:** A panel on the bottom left showing a hierarchy of quantities, with 'B20 1D Exterior Walls' selected.
- Quantities Table:** A table in the bottom center showing the following data:

TypeName	Width (ft)	Length (ft)	Area (sq ft)	AssemblyCode	AssemblyDesc
Exterior - Brick on CMU	1.302	3,785.698	68,474.370	B2010	Exterior Walls
Exterior - Flat Metal Panel on Metal Stud (Clerestory Windows)	0.854		1,292.226	B2010	Exterior Walls
Exterior - MBCI Shadow/Rib on Mt. Stud	1.021		40,305.702	B2010	Exterior Walls
Exterior - Plaster on 4" Mt. Stud	0.625		178.246	B2010	Exterior Walls
Exterior - Plaster on CMU	0.875	1,073.999	15,160.298	B2010	Exterior Walls
Exterior - Plaster on Mt. Stud	0.844		11,440.391	B2010	Exterior Walls
Sketch - 8"		404.646	1,308.031	B2010	Exterior Walls

The interface also features a toolbar at the bottom with options like 'Walk', 'Examine', 'Pick', 'Collect', and 'Auto Fit'. A small thumbnail view of the model is visible in the bottom right corner.

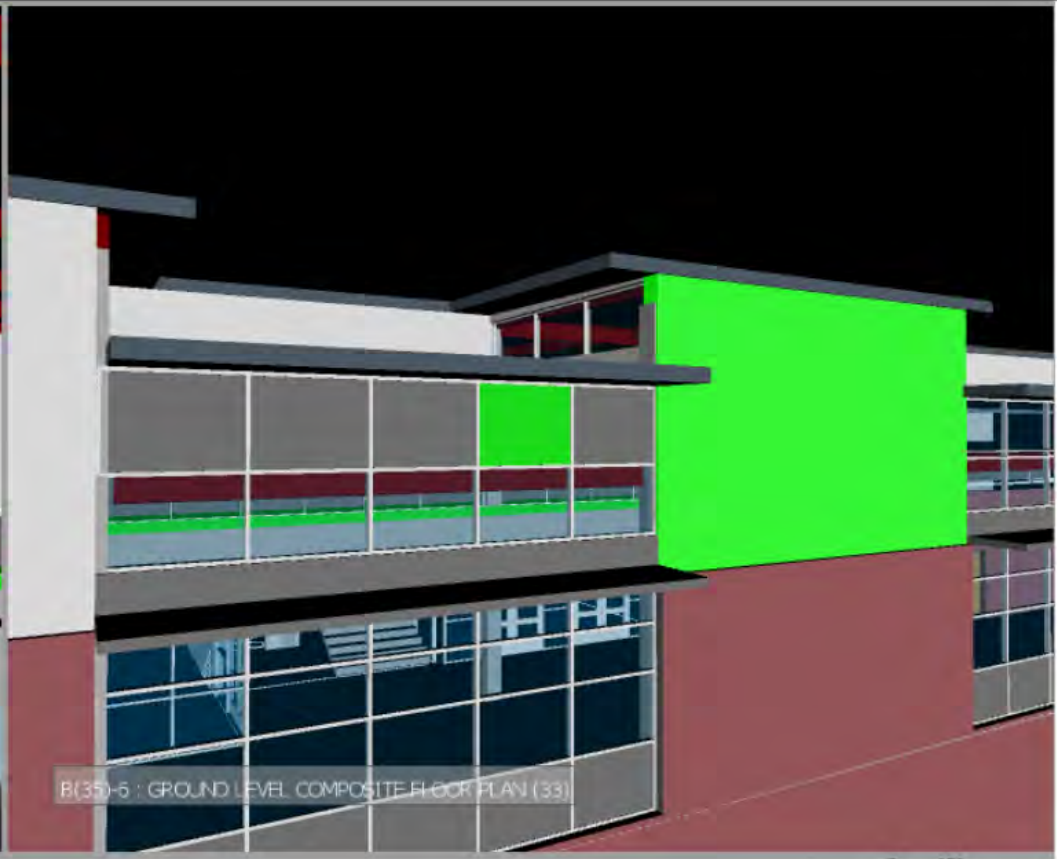
Constructability



MEP STRUCTURE



F(1)-3(-1) : GROUND LEVEL COMPOSITE FLOOR PLAN (34)



B(35)-5 : GROUND LEVEL COMPOSITE FLOOR PLAN (33)

Need to lower the ceiling for cable tray and overhead MEP access



Results

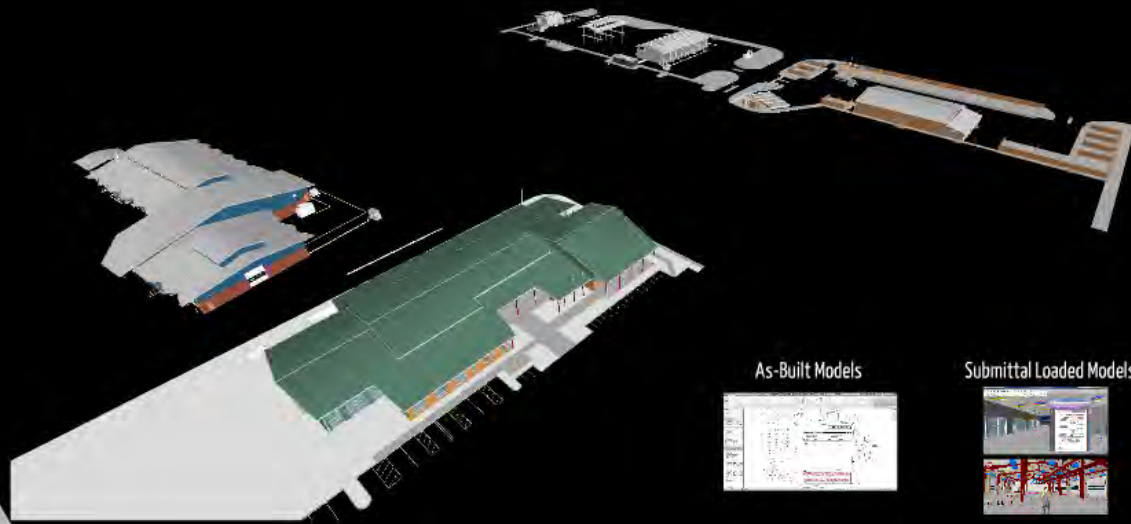
Cost Savings: 2%

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BIM for Facilities Management

San Antonio Northwest Service Center

- Budget: \$16M
- Schedule: 18 months



As-Built Models



Submittal Loaded Models



Results

Cost savings 20-40% on each Model/View/layer created

App. annual operating cost: \$2.2M per facility
RMI: 40% - 55.3% (10% of facility) (with additional 5% with increasing utility, network, security, access, etc.)

Open BIM, Not included:
Construction Management (CM)
RMI for network (20%)
RMI for security (20%)
RMI for access (20%)
RMI for network (20%)



As-Built Models

Autodesk Revit 2013 - HDMG-COSANWSC-11035A-ELEC-BLDG1 - Sheet: E1.102 - BUILDING I - PARTIAL FLOOR PLAN - SEGMENT "B" - LIGHTING

Properties: Sheet, Scale: 1/8" = 1'-0"

Request for information

Project # 11035A - COSA NW Service Center RFI #000

To: Curtis Consulting, 10000 132nd Ave SE, Everett, WA 98203
From: Harold Ford, Jervis General Contractors, Ltd, jford@jgcl.com, 216-648-1088

Date: 03/28/12 Day Set: Space Set: Mark Set:

Subject: External Lighting Fixtures

Question:
Please verify the mounting heights of the type FD light fixtures on the exterior of buildings 1, 2, 3 and 7. Some of the lighting fixtures shown on the Electrical Lighting Floor Plans are not shown on the Architectural Floor Plans.

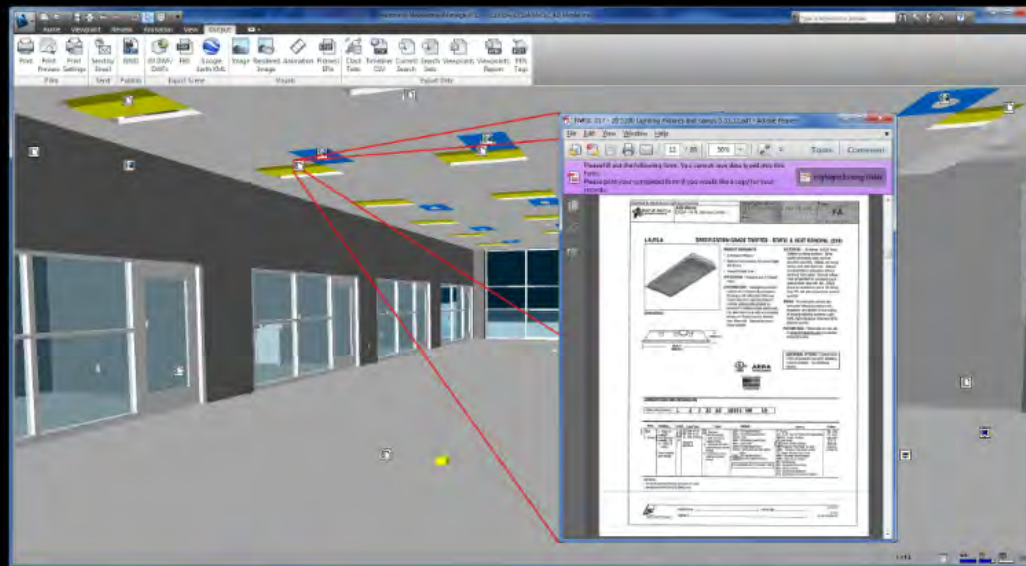
Suggestion:
Schedule Request: TO BE DETERMINED, Cost Impact: TO BE DETERMINED

YOUR PROMPT REVIEW AND RESPONSE IS NECESSARY BY 03/28/12

Reply:
Refer to attached drawings for partial response to RFI 00. Changes include mounting heights of type FD light fixtures at Crew Quarters Bldg. 1 C/W 7 and exclude light fixtures on east side of Assembly Room 1.03 and 1.04 and south wall of Outdoor Seating Area 1.00. These fixtures are still being reviewed. Light fixture heights for Bldgs. 2, 3 and 7 are still being reviewed. Light fixture locations for type FD in the RFI response are to follow attached drawings, and NOT electrical drawings.
03/27/12: Refer to attached drawings for Bldg 1, 3, 4 and V8 wall pack heights and locations. 3 wall packs on the East elevation of Bldg 1 and the South wall of Outdoor Seating will be relocated to the West side of Bldg 1. 1 additional wall pack on the exterior West side of Tree Storage 3.20 will be added. In total of 2 new wall packs will be covered via a North-south LMS.

Click to select, TAB for alternate, CTRL adds, SHIFT unselects.

Submittal Loaded Models



3D BIM

The screenshot displays the Autodesk Navisworks Manage 2013 interface. The main window shows a 3D model of a building interior with a ceiling featuring yellow and blue lighting fixtures. A PDF viewer window titled "NWSC 017 - 26 5100 Lighting Fixtures and Lamps 5.31.12.pdf - Adobe Reader" is overlaid on the right side of the model. The PDF viewer shows a technical specification for a lighting fixture, including a table of luminaires and a list of notes.

Autodesk Navisworks Manage 2013 - 11035A_COSA NWSC_4D Model.nwf

File Edit View Window Help

12 / 80 56% Tools Comment

Please fill out the following form. You cannot save data typed into this form.
Please print your completed form if you would like a copy for your records. [Highlight Existing Fields](#)

LA/FLA SPECIFICATION GRADE TROFFER - STATIC & HEAT REMOVAL (2X4)

PROJECT REQUIREMENTS

- Fast-track assembly
- Optimum lamp spacing to uniform light distribution
- Repair kit per IES

APPLICATION - recessed grid or target finish

CONSTRUCTION - Installation requires installation of electrically enclosed, 20 amp, 120 volt line. Wire may require strap for easy attachment removal. Access doors provided are classified for flexible control placement. Fix. 100-100 frame with concealed blades and 1/8" gaps can be located from other side. (Optional accessories shown available.)

ELECTRICAL - All down ILLUM. kind suitable for clean facilities. Check local emergency code must be specified wherever. Blanks are energy saving, 90-100 watt electronic ballast and incandescent replaceable without removing from ceiling. Maximum voltage must be specified for emergency power options when used with ball. Where lamps are installed as part of the fixture, lamp CFL and color temperature must be specified.

FINISH - All metal parts receive after fabrication laboratory treatment with protective rust inhibitor. Finish coating of housing offering protection to, with white, high reflectance maximum 90% adjustable albedo.

PRENOTES - Please visit our web site at www.hillgroup.com for detailed product literature.

ADDITIONAL OPTIONS - Express select small cell available, see other drawings for more options. See Drawing Details.

LUMINAIRE ORDERING INFORMATION

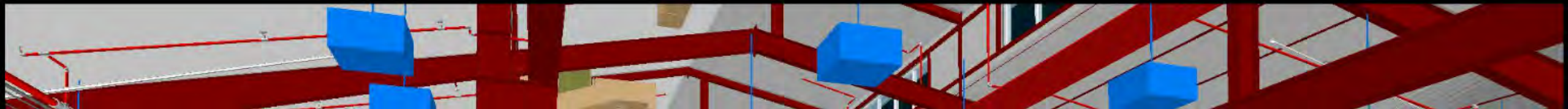
SYMBOL ORDERING: **L A 2 32 50 SSO10 EM UE**

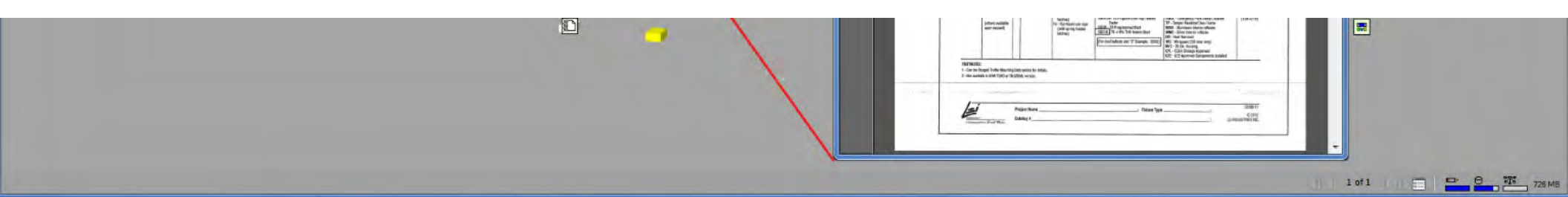
Part	Quantity	Notes	Notes	Notes
1. Troffer	1	See Note 1	See Note 2	See Note 3
2. Ballast	1	See Note 4	See Note 5	See Note 6
3. Lamp	1	See Note 7	See Note 8	See Note 9

NOTES:

- 1 - See Note 10 for details on ordering options.
- 2 - See Note 11 for details on ordering options.

1 of 1 728 MB





Results

Cost Savings= 10-40% on each ticket/work order issued.

Avg annual operating cost=\$8.05 psf annually

R&M Costs= \$1.87- \$2.01 psf annually. (After deducting costs such as cleaning, utilities, Rds/Grnds, Security, Admin, Fixed)

As per BOMA, R&M includes:

Corrective Maintenance=37%

HVAC Equipment 30%

VFD 23%

Ongoing re-commissioning

Assume...

200,000 SF High School

\$2/psf costs annually

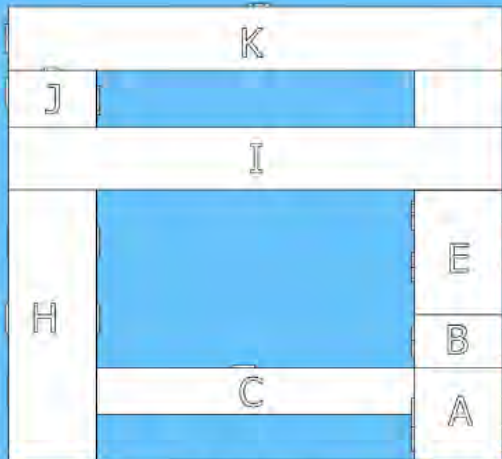
10% savings per issue

\$40,000 potential savings annually

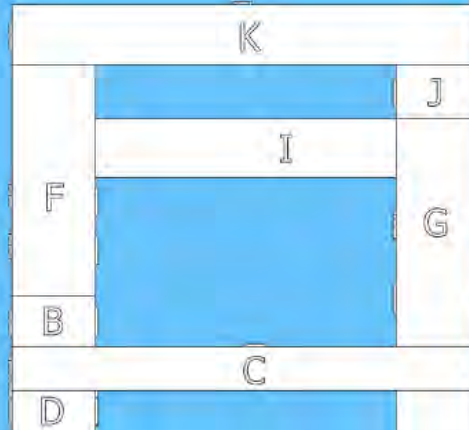
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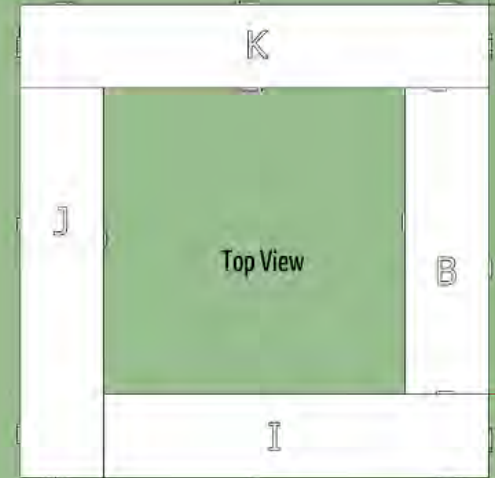
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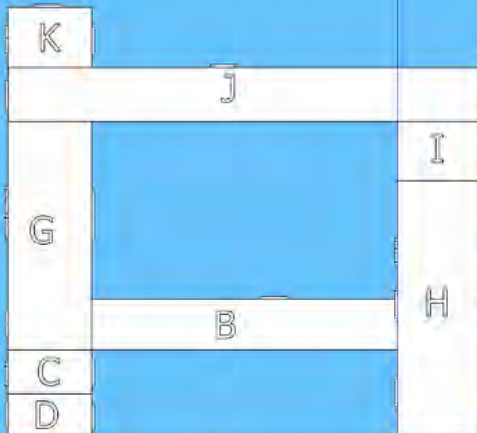
Northern View



Southern View



Top View



Eastern View



Western View

**BLOCK TEST
DEMONSTRATION**

BIM Requirements

Why...

there is a need for owner BIM guidelines,
standards and contracts

How...

to develop the requirements



to incorporate

RFP Process
NBIMS BIM Execution Plan
Contracts
AIA E-202 BIM Addendum
AIA IPD
AGC Consensus Docs 301

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BIM Decision Factors

Project Delivery Method

- CM@R
 - Pre-Construction and Operations
 - Collaboration
- Hard Bid
 - Construction
 - Collaboration
- Design Build
 - Design, Preconstruction and Operations
 - Collaboration
- IPD
 - Design, Preconstruction and Operations
 - Collaboration

Project Type

- Renovation / Addition
- Ground up
- Prototype



Project Complexity

- Science Addition, Central Utility Building, Campus Master plan
- Large MEP component

Budget

- Scope of BIM (Pre-con, Construction, Facilities Management)
- Cost of Implementation vs. Potential Benefits

Time prior to Construction Start

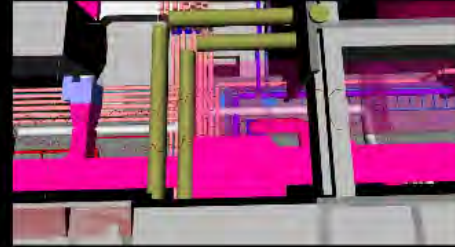
District Size and Expected Growth in the next 3-5 years

Project Delivery Method

- CM@R
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 - Collaboration
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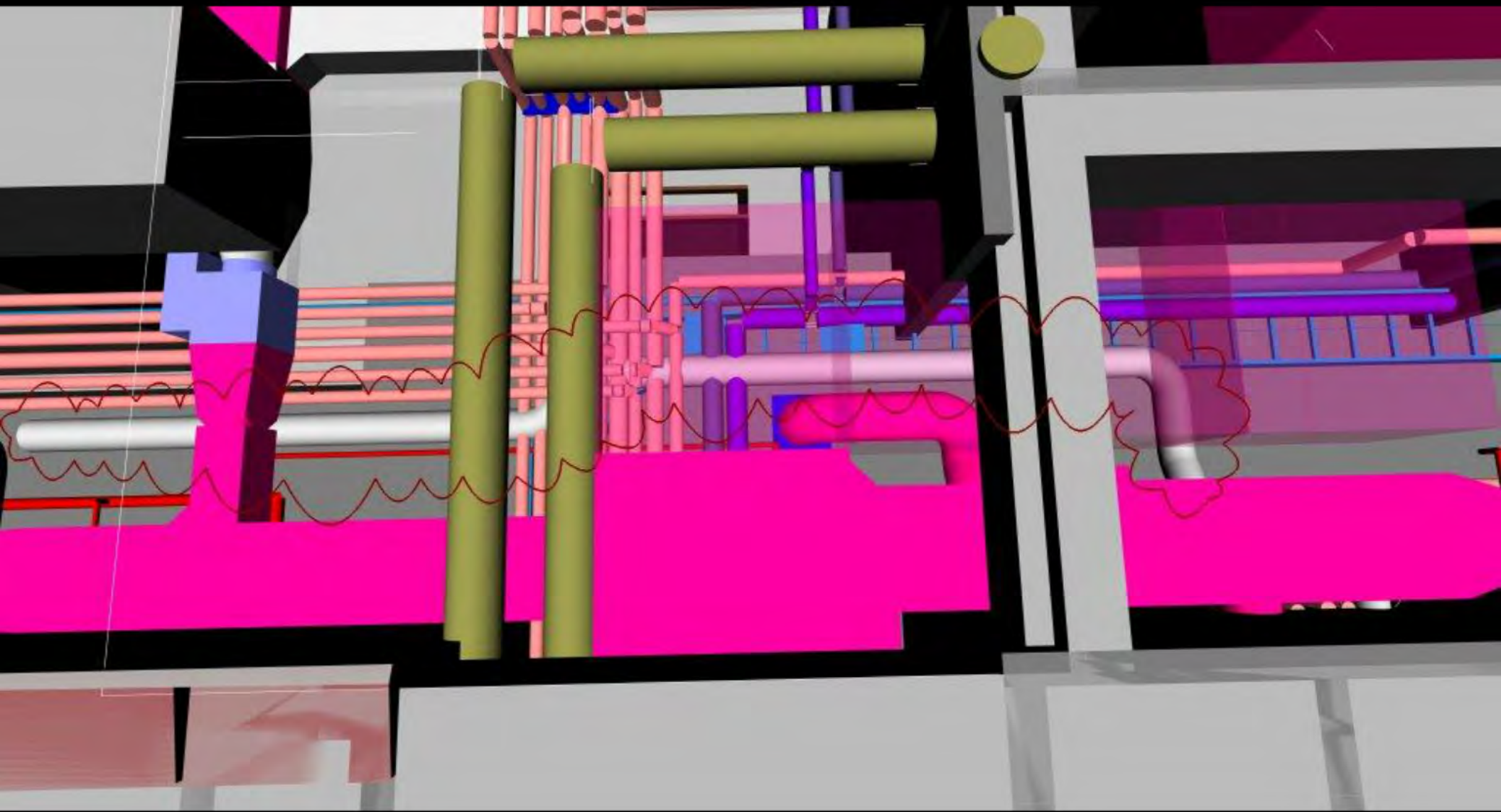
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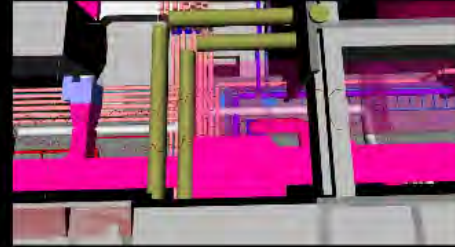
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Take Aways

- Practical Use of BIM in K-12 Construction
- Best Practices for use of BIM
- Establishing BIM Standards
- When does BIM make sense
- When doesn't BIM make sense

Contact

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