

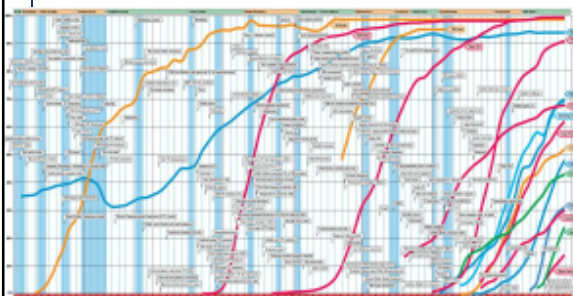
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Integrated Building Solutions for Collaborative Workflow

Brian Krause
National Manager, Integrated Building Solutions
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Pace of Innovation is Accelerating



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Integrated Building Solutions

Integrated Building Solutions – In support of our core business, every phase of construction will be analyzed for process improvement through the use of new technologies, innovative thinking, and solutions integration.

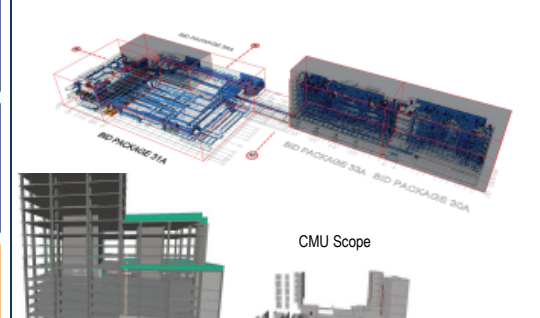
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Integrated Building Solutions for Collaborative Workflow

Plan
Build
Operate
Educate

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Visualization of Scope



Operate

Build

Plan

CMU Scope

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Visualization of Scope



Operate

Build

Plan

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Operate Build Plan

Visualization of Scope

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Operate Build Plan

Visualization of Scope

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Model Based Estimation

Item	Quantity	Unit	Rate	Amount
1.0000	1.0000	1.0000	1.0000	1.0000
2.0000	2.0000	2.0000	2.0000	2.0000
3.0000	3.0000	3.0000	3.0000	3.0000
4.0000	4.0000	4.0000	4.0000	4.0000
5.0000	5.0000	5.0000	5.0000	5.0000
6.0000	6.0000	6.0000	6.0000	6.0000
7.0000	7.0000	7.0000	7.0000	7.0000
8.0000	8.0000	8.0000	8.0000	8.0000
9.0000	9.0000	9.0000	9.0000	9.0000
10.0000	10.0000	10.0000	10.0000	10.0000

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Operate Build

Model Based Estimation

Item	Quantity	Unit	Rate	Amount
1.0000	1.0000	1.0000	1.0000	1.0000
2.0000	2.0000	2.0000	2.0000	2.0000
3.0000	3.0000	3.0000	3.0000	3.0000
4.0000	4.0000	4.0000	4.0000	4.0000
5.0000	5.0000	5.0000	5.0000	5.0000
6.0000	6.0000	6.0000	6.0000	6.0000
7.0000	7.0000	7.0000	7.0000	7.0000
8.0000	8.0000	8.0000	8.0000	8.0000
9.0000	9.0000	9.0000	9.0000	9.0000
10.0000	10.0000	10.0000	10.0000	10.0000

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Operate Build Plan

Voxel iStudio Quantity Model Based Estimation

QUANTIFY

Voxel iStudio Quantity – Takeoff, quantify, model, and report using traditional 2D takeoff methods, but in a 3D environment.

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Operate Build Plan

Voxel iStudio Attribute Content Management

ATTRIBUTE

Voxel iStudio Attribute – Intelligent building information content management in a model based environment.

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Turner Voxel Studio

VOXEL iSTUDIO

QUANTIFY ATTRIBUTE CAPTURE ARcode LIBRARY SCAN MONITOR

Voxel Studio is a series of Turner applications built upon existing software for optimization and additional functionality to drive information, integration, and innovation.
 Voxel Studio can be packaged into different Voxel Studio Suites for project specific uses.

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Total Cost of Ownership

Total Cost of Ownership Summary

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Total Cost of Ownership

Plan Build Operate

Room	Area	Unit Cost	Total Cost	Phase	Unit Cost	Total Cost	Phase	Unit Cost	Total Cost
1	1000	100	100,000	Plan	100	100,000	Build	100	100,000
2	2000	200	400,000	Plan	200	400,000	Build	200	400,000
3	3000	300	900,000	Plan	300	900,000	Build	300	900,000
4	4000	400	1,600,000	Plan	400	1,600,000	Build	400	1,600,000
5	5000	500	2,500,000	Plan	500	2,500,000	Build	500	2,500,000
6	6000	600	3,600,000	Plan	600	3,600,000	Build	600	3,600,000
7	7000	700	4,900,000	Plan	700	4,900,000	Build	700	4,900,000
8	8000	800	6,400,000	Plan	800	6,400,000	Build	800	6,400,000
9	9000	900	8,100,000	Plan	900	8,100,000	Build	900	8,100,000
10	10000	1000	10,000,000	Plan	1000	10,000,000	Build	1000	10,000,000

Lifecycle Studies - Daylight Simulations - Energy Analysis

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Model Based Code Checking

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Permit Submission & Review

Plan Build Operate

NYU Dentistry - Department of Buildings Submission in .dwf for site safety

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Capture Existing Conditions



The School Without Walls High School
District of Columbia
August 11, 2008

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Capture Existing Conditions

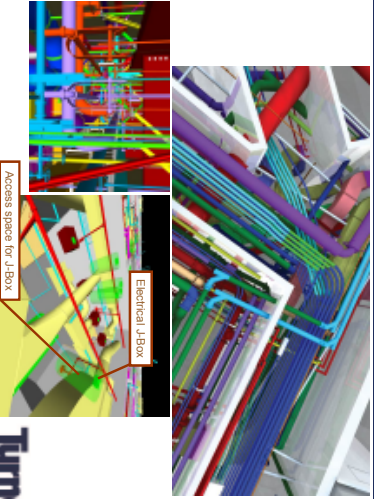


Madison Square Garden - New York, NY

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3D Trade Coordination



Electrical J-Box

Access space for J-Box

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Plan Build Operate

3D Trade Coordination




Martin Luther King Jr. Memorial - Washington, DC

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iRoom Coordination Environment



Fire Sprinkler Coordinator

Plumbing Coordinator

Electrical Coordinator

Mechanical Coordinator


Turner MEP Manager

Ductwork Coordinator

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Plan Build Operate

iRoom Coordination Environment



Seattle, WA

Sacramento, CA

New York, NY

Butler, PA

Salem, OR

Gaithersburg, MD

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Virtual Coordination Environment

- Teleconference
- Webinar
- Collaborative Digital Whiteboard
- Remote Desktop
- Smartboards
- Desktop/Laptop
- iPad

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MEP Process Performance

Number of Clashes

Weekly Coordination Meetings

- Spike 1 - Structure, Sheet Metal, & Plumbing Clashes
- Spike 2 - Clashes with Fire Protection project, MEP systems changed
- Spike 3 - Change to LEED

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MEP Process Performance

Starting Date	Week	Total # of clashes	Total Documented clashes	Percent of total
11/17/2010	13	22	16	72.73%
11/24/2010	14	216	124	58.9%
12/1/2010	16	314	214	68.15%
12/8/2010	17	296	119	40.17%
12/15/2010	18	418	121	28.95%
12/22/2010	20	497	166	33.4%
1/5/2011	21	808	112	13.86%
1/6/2011	21	861	117	13.47%
Avg		406.50	128.75	31.66%

Number of level 2 clashes documented per Coord Meeting

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Coordination Tracking

91.65% CLASH FREE AT RISK REDUCTIONS

December 10, 2010 DMR 22

World Trade Center Tower 2

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Model Based Layout

Combined model reviewed with structural engineer, layout team, and detailers.

Points exported from model to total station for layout.

As-built information overlaid for verification prior to concrete pour.

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Model Based Layout

Traders: Mechanical, Plumbing, Electrical, Fire Protection

Labor Savings > 50% Accuracy > 95%

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Digital Document Management

Turner c.doss
Digital Plan Room

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Visual Production Control

Work In Place Tracking
Visual RACs

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AR via Turner iPad/Phone app

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MEP Systems Prefabrication

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Jobsite Office Prefabrication?

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Results Increased Productivity

Trade	BIM AVERAGE PRODUCTIVITY	NON-BIM AVERAGE PRODUCTIVITY
Mechanical	~300	~210
Electrical	~250	~150
Pipe Production	~200	~150


-143% Increase in Mechanical Productivity
 -67% Increase in Electrical Productivity
 -36% Increase in Pipe Production Productivity

BIM Average Productivity vs. Non-BIM Average Productivity

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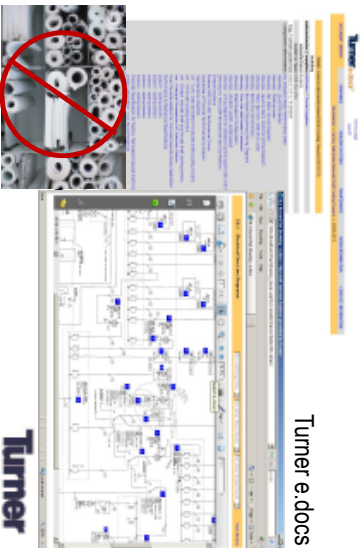
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Digital Facilities Manual

Turner e.docs



Voxel iStudio FM

Plan Build Operate

LIBRARY
Voxel iStudio Library – Visual BIM Interface with drag and drop linked documents cloud synced for sharing and collaboration.

MONITOR
Voxel iStudio Monitor – BMS & CMMS link to the visual BIM Interface.

SCAN
Voxel iStudio Scan – QR code reader and bar code scanning app that connects to the cloud synced BIM based Library to track status & apply real-time information graphically to building assets.



Voxel iStudio FM

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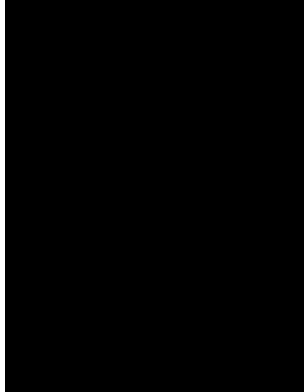
Turner Voxel iStudio Library & Monitor – Cloud Synced Documents & BMS link for temperature & alarm monitoring

- 601 Physical Sensors
- 17,076 Data Points
- 2,250 Points Pooled
- 3,437 Documents
- 14,524 Document Links




Voxel iStudio FM

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Voxel iStudio Scan – QR Code Reader & Bar Code Scanning App to access Voxel iStudio Library & Monitor



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Implementation at Turner

- Senior level support & engagement
- National/Regional talent & support for standards, procedures, education, training, & consistency
- Local talent for project support
- Subcontractor talent for implementation



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Network of Resources



Turner Sharepoint – VDC Internal

- BIM Job Metrics
- BIM Staff Metrics
- BIM Examples
- Recorded Webinar Wednesday Videos
- Streaming Training Videos

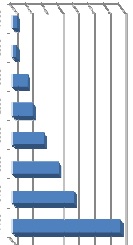

Socialcast – Turner VDC Social Networking Site – www.socialcast.com



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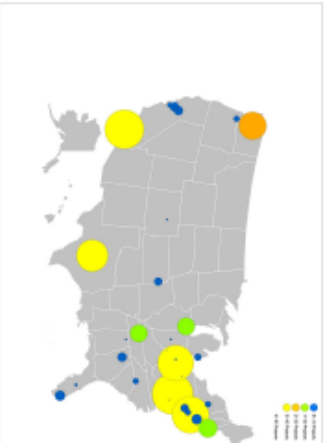

Turner Metrics

- Ranked #1 BIM Implementer in BD&C Magazine in 2010
- Total Number of BIM Projects - 387
- Total BIM Project Estimated Volume - \$21.7 Billion
- Total MEP Clash Projects - 307
- Total Constructability Review Projects - 136
- Total Quantity Take-Off/Cost Estimating Projects - 114
- Total Scheduling/4D Modeling Projects - 128
- Total Laser Scanning Projects – 33
- Total Room Setups in Use – 109

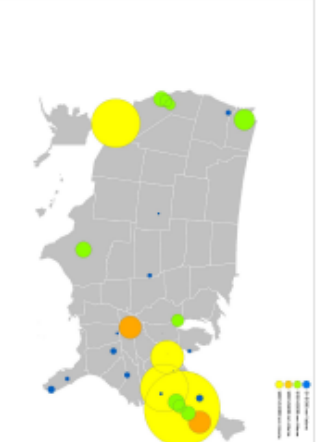

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BIMfographic # of BIM Projects

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BIMfographic Volume of BIM Projects

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Turner BIM University

- 2010 – 11 new BIM recruits
- 2011 – 25 new BIM recruits
- 8-weeks centralized VDC/BIM training
- Weekly topics – Visualization, BIM & 4D, Model Based Scheduling, Model Based Estimating, Coordination, Lean Integration & Optimization
- Weekly Flow: Operations – Tools – Practice
- Advanced BIM Training
- BU/Project Specific Training



Turner BIM University

BIM University 2011 Schedule

Theme	Monday	Tuesday	Wednesday	Thursday	Friday	W
"Model-based Construction"	8:00-9:00 AM: Introduction to BIM	8:00-9:00 AM: Introduction to BIM	8:00-9:00 AM: Introduction to BIM	8:00-9:00 AM: Introduction to BIM	8:00-9:00 AM: Introduction to BIM	8:00-9:00 AM: Introduction to BIM
"Model-based Construction"	9:00-10:00 AM: Introduction to BIM	9:00-10:00 AM: Introduction to BIM	9:00-10:00 AM: Introduction to BIM	9:00-10:00 AM: Introduction to BIM	9:00-10:00 AM: Introduction to BIM	9:00-10:00 AM: Introduction to BIM
"Model-based Construction"	10:00-11:00 AM: Introduction to BIM	10:00-11:00 AM: Introduction to BIM	10:00-11:00 AM: Introduction to BIM	10:00-11:00 AM: Introduction to BIM	10:00-11:00 AM: Introduction to BIM	10:00-11:00 AM: Introduction to BIM
"Model-based Construction"	11:00-12:00 PM: Introduction to BIM	11:00-12:00 PM: Introduction to BIM	11:00-12:00 PM: Introduction to BIM	11:00-12:00 PM: Introduction to BIM	11:00-12:00 PM: Introduction to BIM	11:00-12:00 PM: Introduction to BIM
"Model-based Construction"	12:00-1:00 PM: Introduction to BIM	12:00-1:00 PM: Introduction to BIM	12:00-1:00 PM: Introduction to BIM	12:00-1:00 PM: Introduction to BIM	12:00-1:00 PM: Introduction to BIM	12:00-1:00 PM: Introduction to BIM
"Model-based Construction"	1:00-2:00 PM: Introduction to BIM	1:00-2:00 PM: Introduction to BIM	1:00-2:00 PM: Introduction to BIM	1:00-2:00 PM: Introduction to BIM	1:00-2:00 PM: Introduction to BIM	1:00-2:00 PM: Introduction to BIM
"Model-based Construction"	2:00-3:00 PM: Introduction to BIM	2:00-3:00 PM: Introduction to BIM	2:00-3:00 PM: Introduction to BIM	2:00-3:00 PM: Introduction to BIM	2:00-3:00 PM: Introduction to BIM	2:00-3:00 PM: Introduction to BIM
"Model-based Construction"	3:00-4:00 PM: Introduction to BIM	3:00-4:00 PM: Introduction to BIM	3:00-4:00 PM: Introduction to BIM	3:00-4:00 PM: Introduction to BIM	3:00-4:00 PM: Introduction to BIM	3:00-4:00 PM: Introduction to BIM
"Model-based Construction"	4:00-5:00 PM: Introduction to BIM	4:00-5:00 PM: Introduction to BIM	4:00-5:00 PM: Introduction to BIM	4:00-5:00 PM: Introduction to BIM	4:00-5:00 PM: Introduction to BIM	4:00-5:00 PM: Introduction to BIM
"Model-based Construction"	5:00-6:00 PM: Introduction to BIM	5:00-6:00 PM: Introduction to BIM	5:00-6:00 PM: Introduction to BIM	5:00-6:00 PM: Introduction to BIM	5:00-6:00 PM: Introduction to BIM	5:00-6:00 PM: Introduction to BIM

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Turner Innovation Series



TURNER
INNOVATION
SERIES

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Implementation at Turner

- Learn how to build
- Learn a 3D model or analysis software – Google Sketchup, Navisworks Freedom
- Identify current inefficiencies in the process
- Identify potential project issues
- Identify where technology can help inefficiencies, solve issues, or improve current process workflow
- Select the appropriate technology

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Integrated Building Solutions for Collaborative Workflow

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