

Integrating Facilities Management with Coordination of Trades at The MathWorks, Natick MA

\$300K or *\$12K*

Project – Who?

- VDC Services Team (*leaders*)
- The MathWorks (*owner / funder*)
 - *Capital planning department (visionaries)*
 - *Facilities Management department (end users)*
- Cranshaw Construction (*builder*)
- Subcontractors (*contributors*)

Project – What?

- Coordination Resolution by Vico
 - *On behalf of all subcontractors*
 - *Using System Priority Structure (SPS)*
 - *2D deliverables: Install drawings and CR reports*
 - *FM done in conjunction with coordination*
- ***FM was no ‘extra’ work at project end***

Project – Why?

- Detailed tracking of:
 - *Calculated occupancy costs*
 - *Space types*
 - *Maintenance and equipment requirements*
 - *Documentation of possible energy cost savings*
- ***Proactive building management***

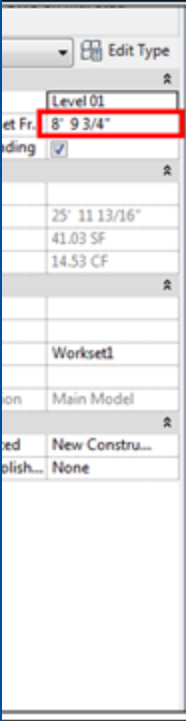
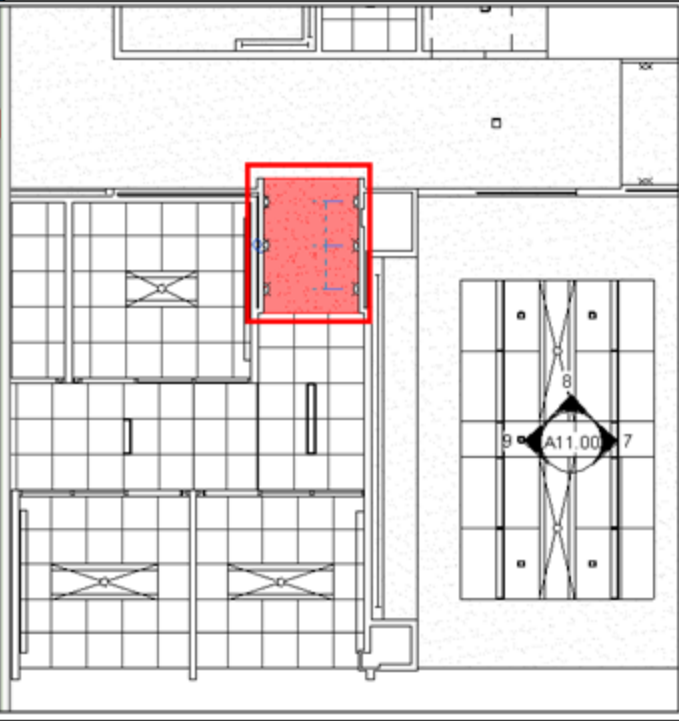


Project – How?

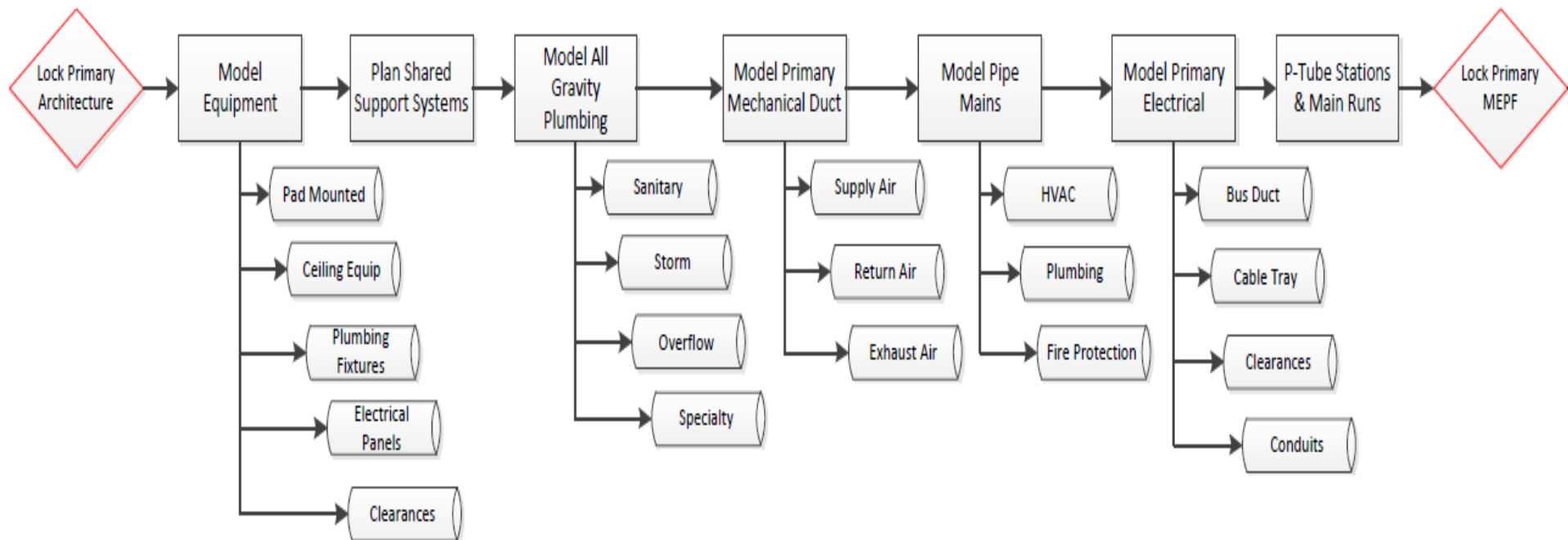
- **Lean Coordination, using System Priority Structure (SPS)**
 - Vico began by validating the design model to ensure it matched 2D docs – *It didn't!*
 - Design model was fixed to match contract docs
 - Vico took the lead coordinating for **all trades**
- Resulting models were in **common platform, using common conventions**
- **FM meta data** input into as-built models

Design Model Evaluation – For FM:

		Is part of the scope?	Usability		Consistency				Quality			4D / 5D		Score Rate: 0%-100%	Notes
			File format Rate: 0-1	File size Rate: 0-1	Modeling techniques Rate: 0-3	Content Rate: 0-3	LOD Rate: 0-3	Completeness Rate: 0-3	Naming convention Rate: 0-3	3D Quality Review Rate: 0-3	2D Spot check Rate: 0-3	4D Scheduling Rate: 0-3	5D Estimate Rate: 0-3		
Interior			66%	66%	39%	50%		38%	31%	36%	47%			46%	
Internal Walls & Partitions			63%	63%	44%	56%		52%	22%	44%	44%			48%	
C1010	Precast walls	inc	0	0	0	0	-	0	0	0	0	-	-	0%	The contract calls out for precast walls, but such elements can't be identified in the model, based on the current naming convention
C1010	Masonry walls	inc	0	0	0	0	-	0	0	0	0	-	-	0%	The contract calls out for precast walls, but such elements can't be identified in the model, based on the current naming convention
C1010	Stud walls	inc	1	1	3	3	-	2	2	2	2	-	-	80%	All the stud walls were modeled under the name of 'Basic Wall'. They have got their own IDs to make them different.
C1010	Stud wall framing	exc	-	-	-	-	-	-	-	-	-	-	-		
C1010	In-wall fire- and soundproofing	exc	-	-	-	-	-	-	-	-	-	-	-		
C1010	Glazed walls (glazed & solid areas)	inc	1	1	2	3	-	3	1	3	3	-	-	85%	Glazed walls were modeled with curtain wall element. The naming convention is not detailed enough, coding or differentiating by type is missing
C1010	Glazed wall framing	inc	1	1	2	3	-	3	1	3	3	-	-	85%	Glazed walls were modeled with curtain wall element. The naming convention is not detailed enough, coding or differentiating by type is missing
C1010	Proprietary walls	inc	0	0	0	0	-	0	0	0	0	-	-	0%	The contract calls out for precast walls, but such elements can't be identified in the model, based on the current naming convention
C1010	Toilet partitions	inc	0	0	0	0	-	0	0	0	0	-	-	0%	The contract calls out for precast walls, but such elements can't be identified in the model, based on the current naming convention
C1030	Handrails & balustrade	exc	-	-	-	-	-	-	-	-	-	-	-		
C1020	Interior doors	inc	1	1	3	3	-	3	1	2	2			80%	The naming convention is not consequent enough.
C1020	Interior windows & glazed openings	inc	1	1	2	3	-	3	1	2	2	-	-	75%	There are glazed walls in the model what are should be interior glazed doors. These doors are appeared with wrong quantities in Vico Office.

ID	ME-017	Floor	General	Grid Reference	General
Description	Elevation of C3030_Suspended Ceilings is not correct in design model. Model reflects ceilings at 8'-9 3/4" elevation but 2D prints indicate that ceilings are 9'-0" U.O.N.				
					<ol style="list-style-type: none"> 1 ALL CEILING HEIGHTS TO BE 9'-0" , U.O.N. 2 ALL CEILING TILE TO BE ACT-01, U.O.N. 3 ALL CEILINGS TO BE CENTERED IN ROOM AS SHOWN ON PLAN, U.O.N. 4 ALL ACT CEILINGS IN CORRIDORS ARE ABSOLUTE EVEN DIMENSIONS. HOLD TILE TO CORRIDOR WIDTH NOTED ON PLAN. 5 SHADED CEILING TILES ON PLAN ARE FLEXIBLE AREAS ALLOWING THE INSTALLER TO ADJUST THE LAYOUT TO THE NEXT ADJACENT FIXED DIMENSION.
Impact	All ceiling elevations in model must be updated to match notes on 2D prints, so that FM model matches construction.				

SPS Coordination - Process:



System num 1

System

Duct

Element

Duct - straight - largest side = 22"

Number of runs

1

System num 2

System

Hydronic Piping

Element

Steel - pipe - 5" - 8"

Number of runs

4

Solution

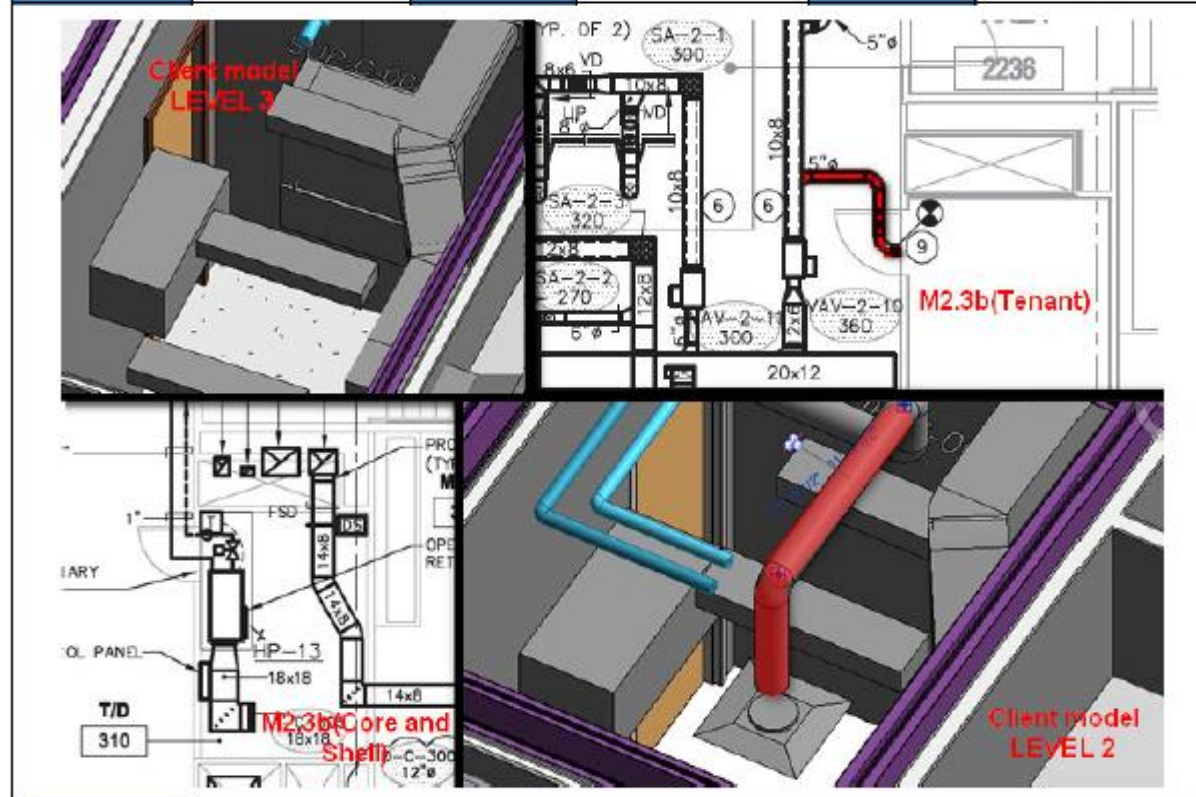
In order to avoid clash modify the following system

Duct - straight - largest side = 22"

The severity ranking of this issue is

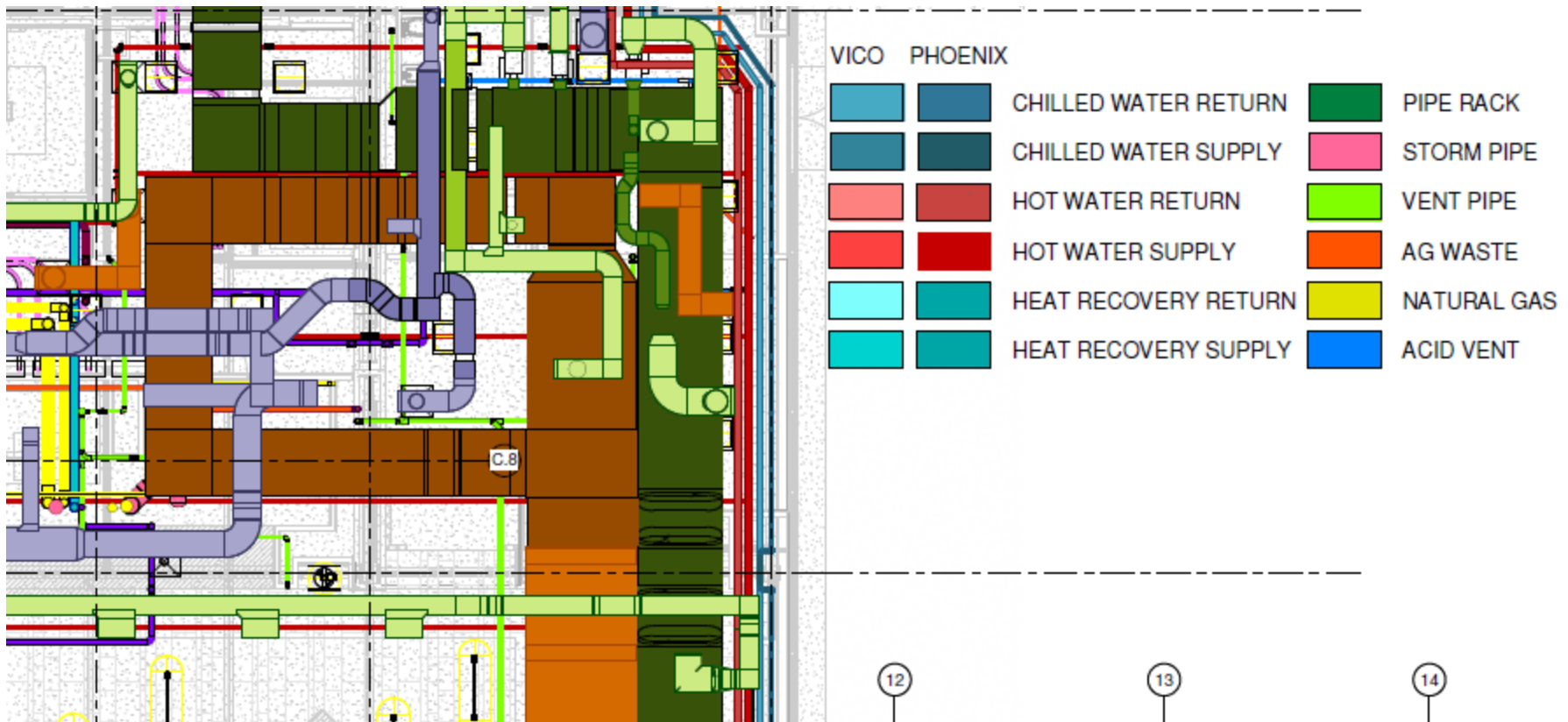
25

CRI Number:	MEP-F-020	Trades:	MH	Severity:	Medium
Description:	Contradiction between the M2.3b (Core and Shell), M2.3b (Tenant) plans. The 5" diam. supply air duct should have continuation according to the Tenant plan but there is nothing shown for that in the Core & Shell plan. The Phoenix model shows the duct only on the second floor.				
Floor:	LEVEL 2-3	Grid Reference:	C-D/8-9	Sheet Reference:	M2.3b (Core and Shell), M2.3b (Tenant)



Most installers don't "do BIM!"

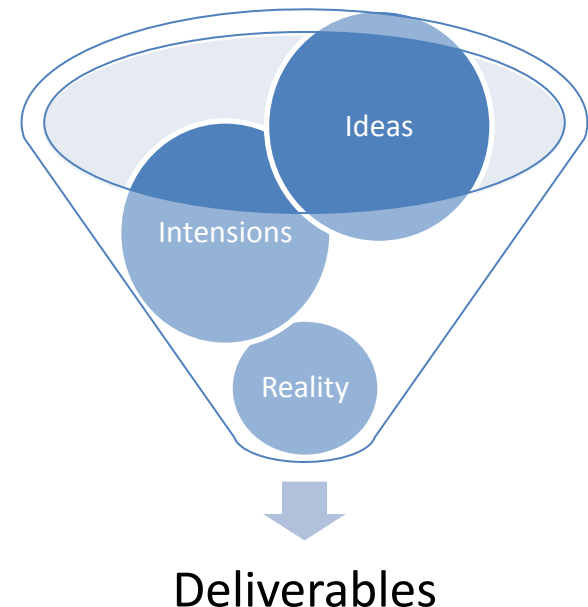
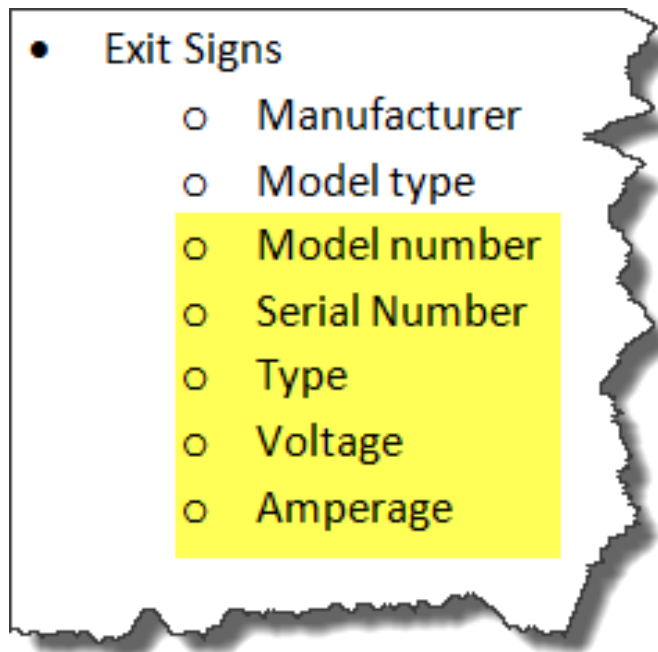
SPS Coordination – Deliverables:



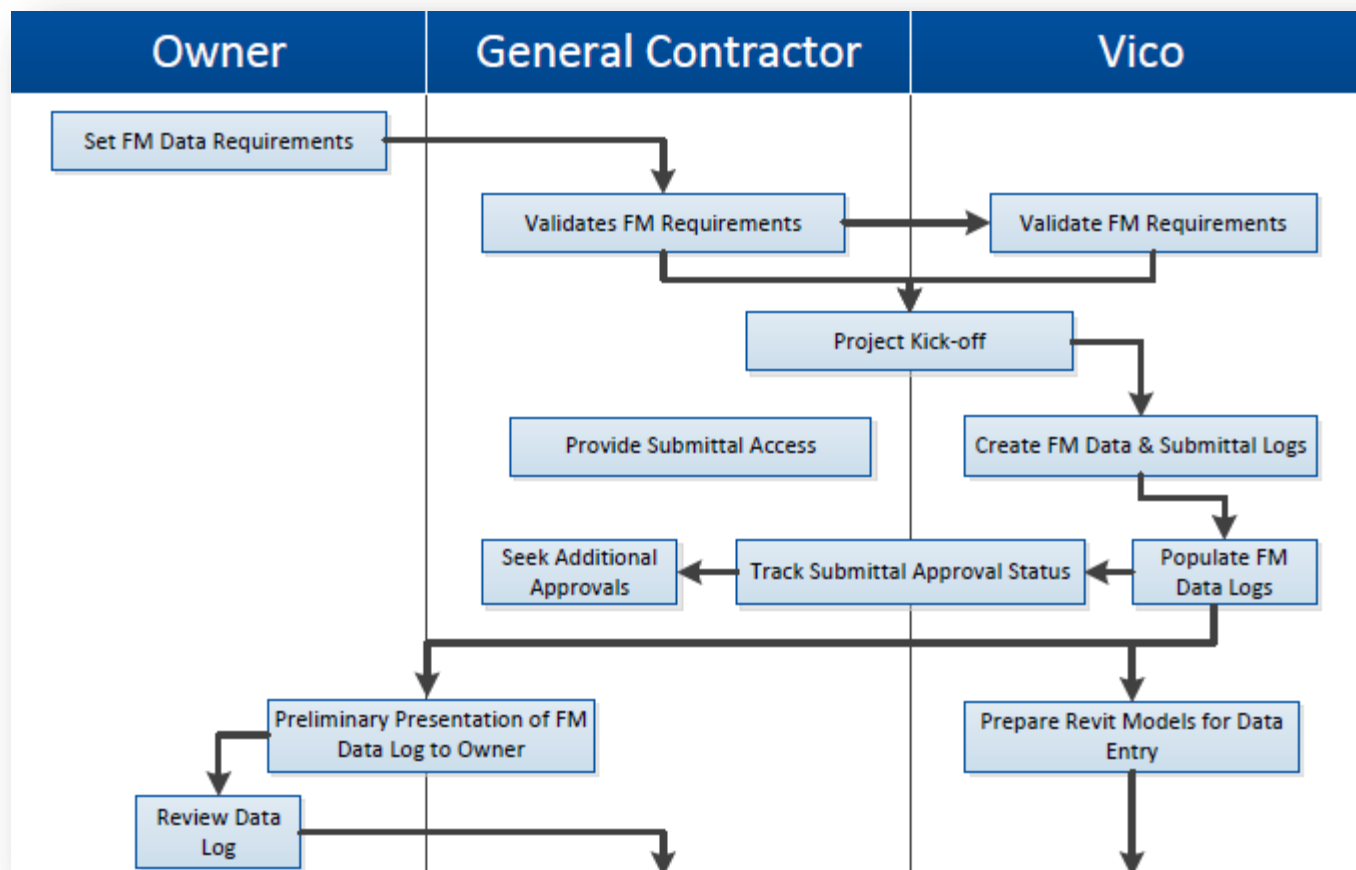
Most end users don't "do BIM!"

Process - FM Requirements:

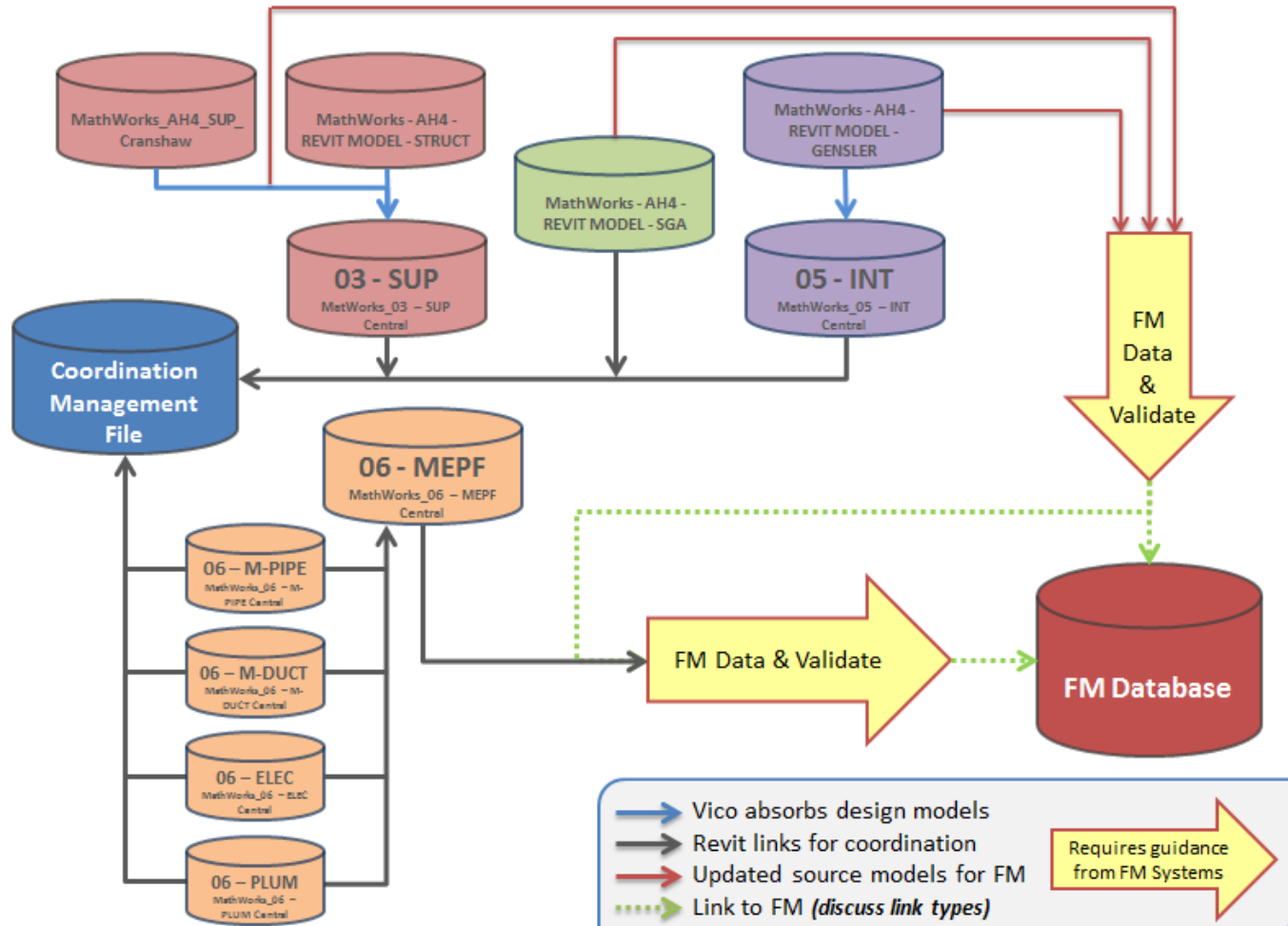
- Started out **very extensive** (16 pages) – evolved to be **fewer** (1 spreadsheet) **and more accurate!**



Process – FM Execution I:



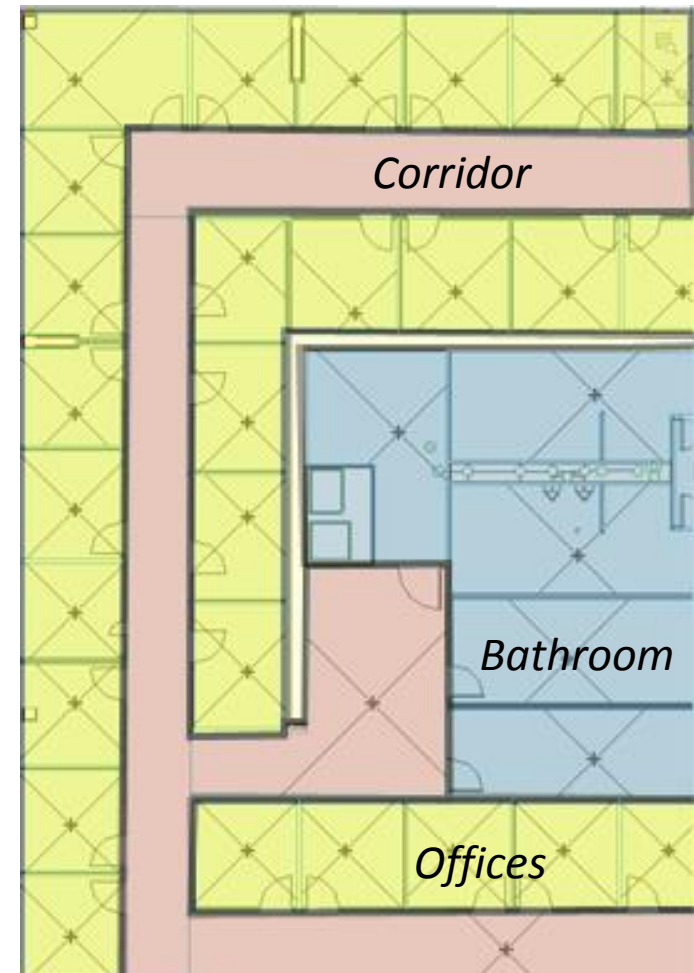
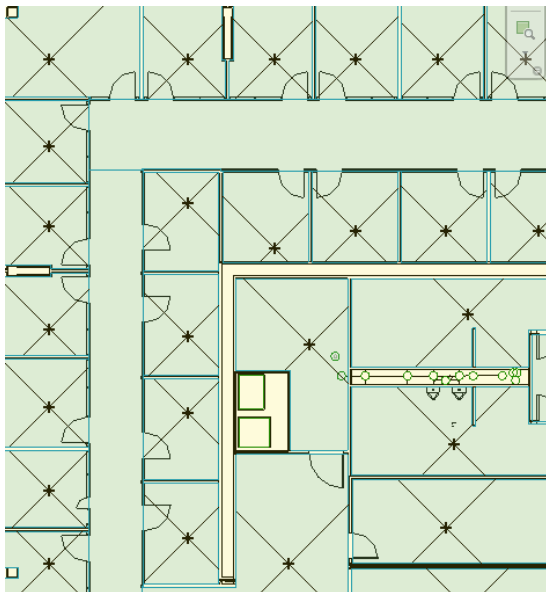
Process – Model setup:



		Chillers		CH-2		CH-3				
Estimated time to complete (hr):	5	Manufacturer	Type	YORK		YORK				
Time spent (hr):	3	Model Number	Type	YMC2 S0985		YMC2 S0985				
Percent complete:	90%	Serial Number	Copy of Mechanical Equipment Schedu							
Time remaining (hr):	0	Size (Tonnage)	Mark	Level	Manufacturer	Model Num	Size (GPM)	Amperage	Voltage	HP
Modeled as part of:	MEPF	Refrigerant Type	RCP-4_5'-6"	Level 4	PRICE	EP009	2.5	12	120/208	.75
		Electrical Feed Amperage	RCP-4_5'-6"	Level 4	PRICE	EP009	2.5	12	120/208	.75
		Electrical Feed Voltage	RCP-4_25'-8"	Level 4	PRICE	EP009	2.5	12	120/208	.75
		Condensator Tube Count (qt)	RCP-4_25'-10"	Level 4	PRICE	EP009	2.5	12	120/208	.75
		Evaporator Tube Count (qt)	RCP-C-1_14'-0"	Level 4	PRICE	EP009	2.5	12	120/208	.75
		Relief Size (GPH)	VAV-4-1	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-2	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-3	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-4	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-5	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-6	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-7	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-8	Level 4	PRICE	GC-162	5	14	120/208	1.25
			VAV-4-8A	Level 4	PRICE	GN-184	5	14	120/208	1.25
		Manufacturer	Instance							
		Model Number	Instance							
		Serial Number	Instance							
		Size (Tonnage)								
		Cooling Tower Type								
		Voltage								
		Amperage								
		Flow (GPM)								
		Chemical Treatment (Chem)								
		Motor - Size (HP)								
		Motor - Size (dimensional)								
		Motor - Amperage								
		Motor - Voltage								
		Motor - Shiv Manufacturer								
		Motor - Shiv Reference Number								

Room Spaces

- Design names vs. use names
- “Use areas” (corridors, labs, back of house, etc.)



Connect to FM:Interact
Edit Room
Register Model
Edit Area
Add-in Options
Rooms To Areas
Synchronize Space
Synchronize Assets
Publish DWG

Properties

D3066_010_M-VAV-Size_6

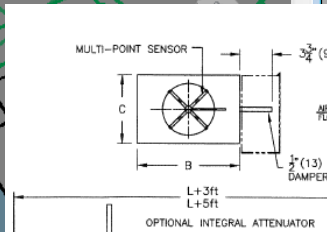
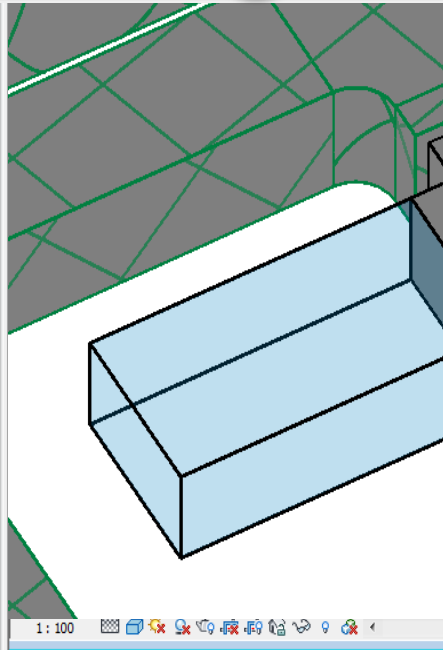
Mechanical Equipment (1) Edit Type

Constraints

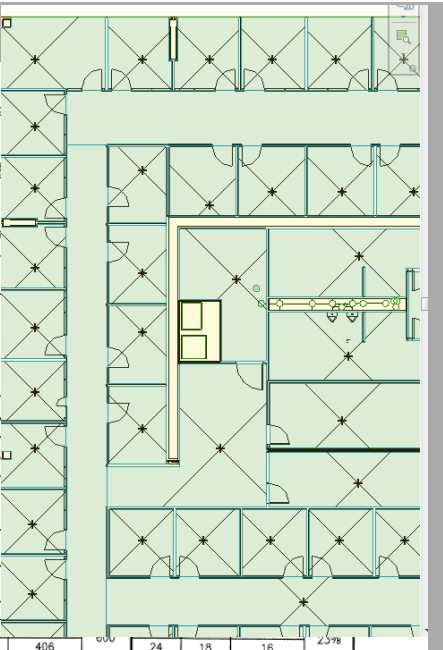
Ext

Amperage	12
Blower Wheel Size	6"
Boiler Type	n/a
BTU Input	0
BTU Output	14
CFM	210
CFM Min/Max	265/330
Chemical Treatment (Chemical...)	n/a
Condenser Tube Count (qty)	n/a
Cooling Tower Type	n/a
Crack Unit Type	n/a
Decibels	23
Diffuser Type	Type D
Drive Type	Direct
Electrical Feed Amperage	12
Electrical Feed Voltage	120 / 208
Evaporator Tube Count (qty)	none
Exchanger Type	n/a
Flow (Ft/min)	n/a
Flow (GPM)	1.25
Frame Type	Aluminum
Fuel Source	Electric
HP	.75
Inlet/Outlet Size (dia)	8" x 8"
Model Number	E9009
Modulator Motor Size (HP)	.75
Motor - Amperage	12
Motor - Belt Size (Part Number)	P159386
Motor - Filters	8" x 8"
Motor - Shiv Manufacturer	Price:176
Motor - Shiv Reference Number	Price:176
Motor - Size (Dimensional)	6"
Motor - Size (HP)	.75
Motor - Voltage	120 / 208

Properties help Apply



UNIT SIZE	MAX L/S	MAX CFM	S.I. OUTLET	
			B	C
4	106	225		
5	165	350	305	203
6	212	450		
7	307	650	305	254
8	378	800		
9	496	1050		
10	637	1350	356	318
12	991	2100	406	381
14	1416	3000	508	445
16	1888	4000	610	457



Mark	Level	Manufacturer	Model Num	Size
RCP-4_5-6"	Level 4	PRICE	EP009	2.5
RCP-4_5-6"	Level 4	PRICE	EP009	2.5
RCP-4_25-8"	Level 4	PRICE	EP009	2.5
RCP-4_25-10"	Level 4	PRICE	EP009	2.5
RCP-C-1_14-0"	Level 4	PRICE	EP009	2.5
VAV-4-1	Level 4	PRICE	GC-162	5
VAV-4-2	Level 4	PRICE	GC-162	5
VAV-4-3	Level 4	PRICE	GC-162	5
VAV-4-4	Level 4	PRICE	GC-162	5
VAV-4-5	Level 4	PRICE	GC-162	5
VAV-4-6	Level 4	PRICE	GC-162	5
VAV-4-7	Level 4	PRICE	GC-162	5
VAV-4-8	Level 4	PRICE	GC-162	5
VAV-4-8A	Level 4	PRICE	GN-184	5

- NOTES:**
- INTERNAL INSULATION 1/2" (13mm) THICK FIBERGLASS (1 1/2 lb DENSITY) WHICH MEETS REQUIREMENTS OF NFPA 90A & UL181.
 - ALL INTERNAL INSULATION SEAMS SEALED WITH DUCT SEALER (FIBERGLASS LINER) OR HARDCAST 1602 TAPE (ALL OTHER LINERS).
 - 22GA. ZINC COATED STEEL HOUSING INTERNALLY SEALED AND GASKETED, LEAK RESISTANT CONSTRUCTION.
 - RECTANGULAR DISCHARGE OPENING WITH SLIP AND DRIVE CLEAT DUCT CONNECTION.
 - LOW LEAKAGE DAMPER CONSTRUCTION - DOUBLE GASKET.
 - LEAKAGE CERTIFICATION LABEL PROVIDED BY FACTORY (CLL3 & CLL6 ONLY).
 - DIGITAL CONTROLS BY CONTROL CONTRACTOR.

- OPTIONS:**
- CLL0-CLL CONSTRUCTION WITHOUT FACTORY CERTIFICATION
 - CLL3-FACTORY TESTED UP TO 1.5% OF MAX DESIGN FLOW AT UP TO 3" W.G.
 - CLL6-FACTORY TESTED UP TO 1.5% OF MAX DESIGN FLOW AT UP TO 6" W.G.
 - CONTROLS ENCLOSURE
 - DISCONNECT SWITCH
 - 20ga CASING
 - INTEGRAL ATTENUATOR
- LINER OPTIONS:**
- FF
 - FF1
 - FB
 - CRWF
 - CRF1
 - FG1
 - FF50
 - CRWF
 - FB1
 - CRF1
 - FG75

Lessons Learned

- Agree on ***practical requirements*** early
- Get the ***end user*** involved early
- Understand the ***evolving nature*** and importance of ***room spaces*** and names relative to FM!
- Active ***submittal management*** is required and should be an ***assigned responsibility***

Lessons Learned

- Include FM data and make as-built updates in sequence with the work; **avoid** letting it be an **afterthought**
- Exchange **smaller milestone** files before working too far. This will ensure data compatibility and **avoid rework!**

Was the integration helpful?

This project highlights innovation in both the processes and technology required to support the integration of BIM and FM. Although their contract only specified a basic requirement to deliver a BIM model, during the course of the project MathWorks realized that a more detailed definition of deliverables was critical. While the GC and its team of subcontractors were very skilled at their core disciplines, there

were various levels of BIM maturity. They found a BIM Consultant in the early phase. SG&A found a BIM Consultant with a large data population, and they used different BIM models. The BIM Consultant was AutoCAD-based.

BIM Consultant – Vico Software

Vico Software is a BIM consultant who provides construction software and services to the construction industry throughout the country. (<http://www.vicosoftware.com/>) Vico's local office in Salem, MA was recommended by Cranshaw Construction and selected by MathWorks on a Qualifications Based Selection. On this particular project, they had the responsibility for coordinating all CAD and BIM documents between the owner, designers, contractor, and subcontractors. Mechanical, electrical, and plumbing coordination was critical in this project and all pipes over one inch and conduit over one and one-half inches were modeled. After running the developed model, size and location conflicts were easily found and were able to be corrected throughout design development and not during construction. Vico was critical in this process and their coordination efforts were advantageous to all parties. The chart below shows the flow of information between all parties. (Bernardi & Donahue, 2012)

Thank You!!

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On: **Linked in**