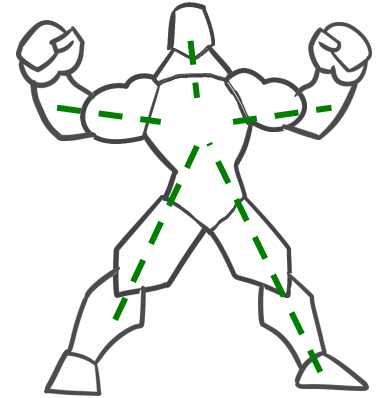
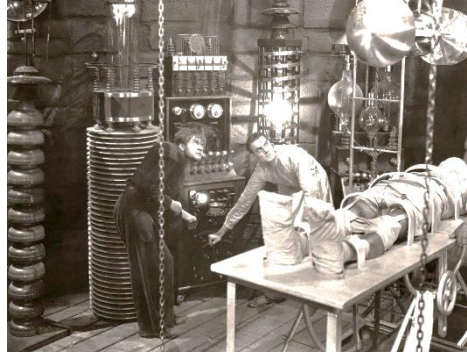
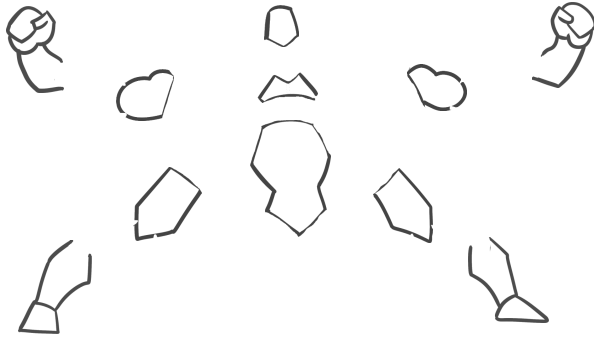


Sewing Together the Amputated Digital Twin

(BuildingSmart Feb 2020)



Luke Johnson

VDC Implementation Director

Yet Another Misused and Misunderstood Term

A **digital twin** is a digital replica of a living or non-living physical entity.^[1]

Digital twin refers to a digital **replica** of potential and actual physical assets ([physical twin](#)), processes, people, places, systems and devices that can be used for various purposes.^[2]

The digital representation provides both the elements and the dynamics of how an [Internet of things](#) device **operates and lives throughout its life cycle**.^[3]

Definitions of digital twin technology used in prior research emphasize two important characteristics.

- Firstly, each definition emphasizes the **connection** between the physical model and the corresponding virtual model or virtual counterpart.^[4]
- Secondly, this connection is established by generating **real time data** using sensors.

Is Your Digital Really a Twin?

- **Accurate** 3D Representation, usually As-Built
- Accurate operational data is embedded or **linked** directly to elements (not siloed or disconnected)
- There is a '**live**' connection to some data environment or monitoring sensors
- There is an **ongoing process of updating, feeding and maintaining the digital asset** with any changes to linked data or the physical asset/s or sensors

What you
intended
... ?

Physical ↔ **Digital Twin**

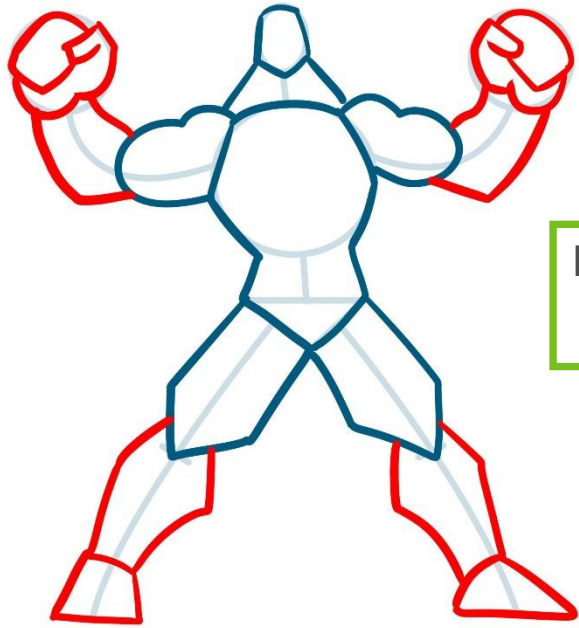


... vs What You Might Actually Have

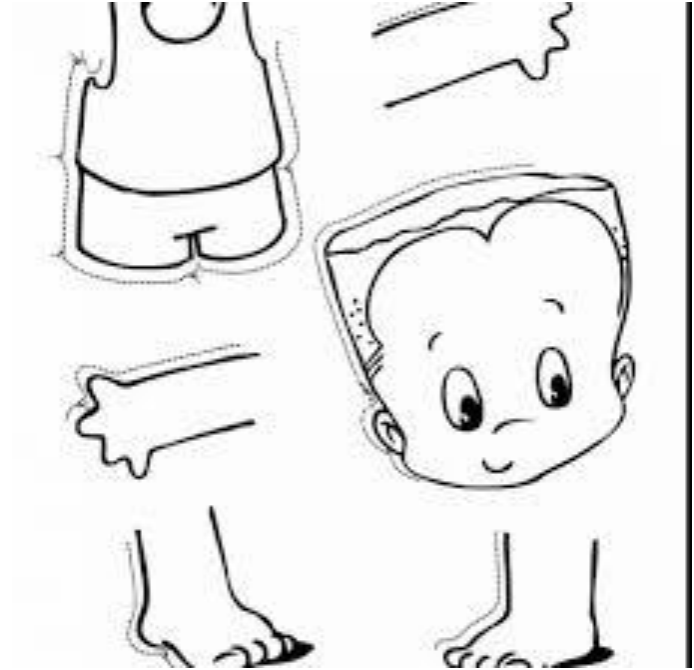


- **Not As-Built**
- Data is in a separate **silos**
- All connections are **manual** push-pull
- No clear **process** for **updating**

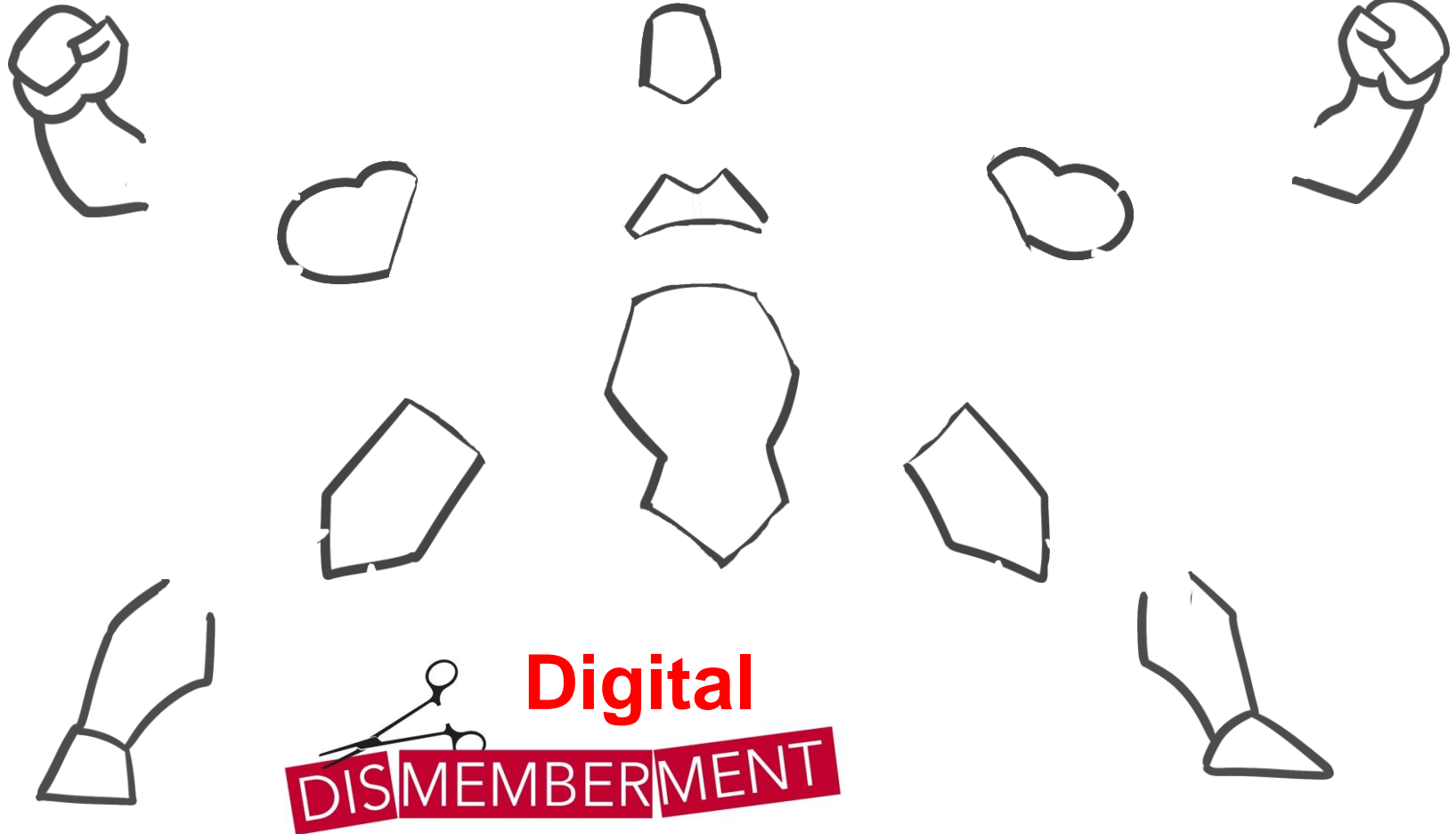
What Often Happens...



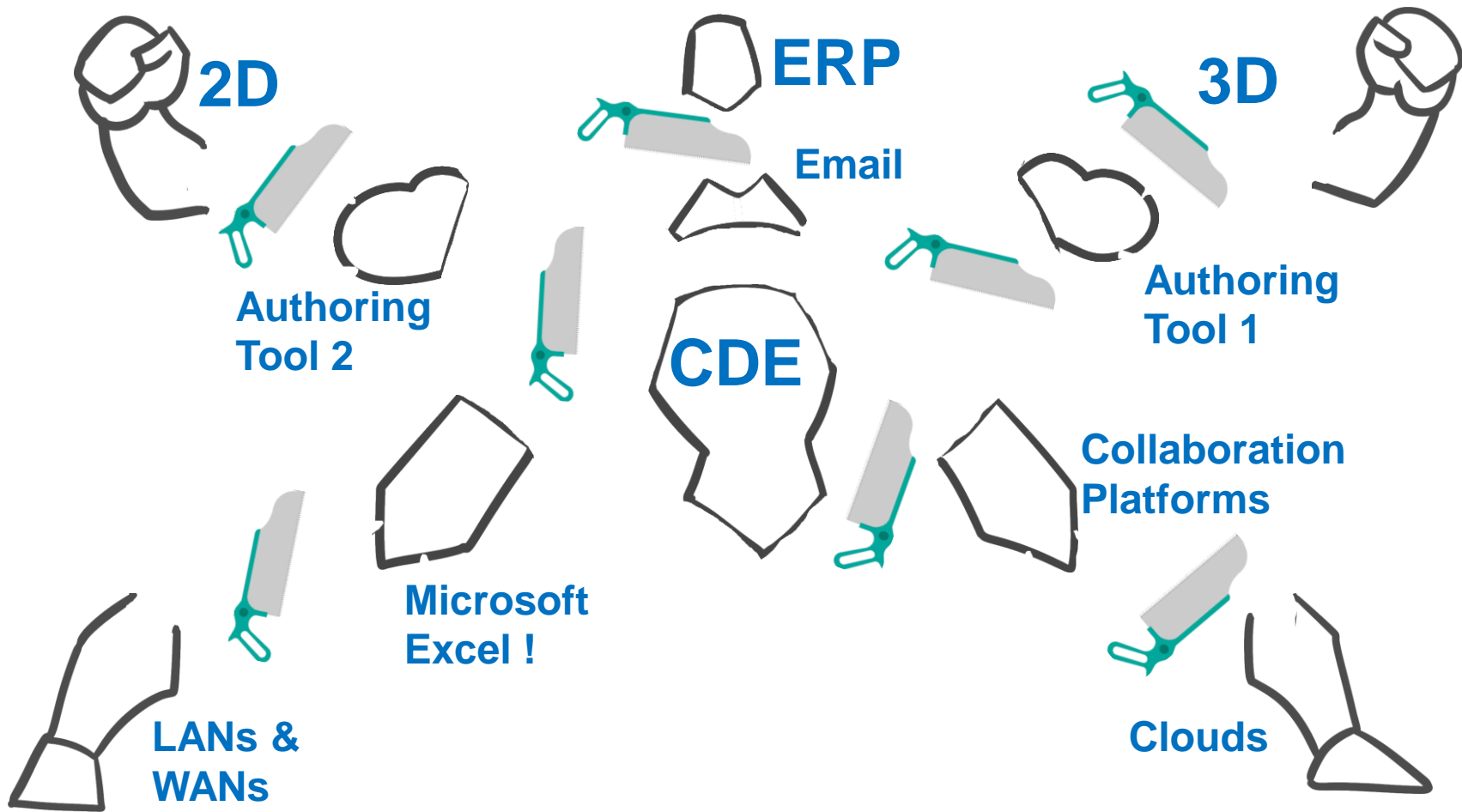
Project
Lifecycle



What Is Actually Going Wrong?



Is This Really a Digital Twin?



Amputation Methods



- Teams with different interests or **goals**
(making a perfect digital twin is rarely a shared goal)



- Disparate **proprietary** platforms
(without opportunity for integration or ‘openness’)



- **Security** and technical barriers
(certain repositories not open to all parties)



- Lack of human resource **continuity**
(people come and go on the project, even digital leaders)

Data Loss and Digital Obsolescence



- **Data loss** is an error condition in [information systems](#) in which information is destroyed by failures or **neglect** in [storage](#), [transmission](#), or [processing](#).



- **Digital obsolescence** is a situation where a digital resource is no longer readable because of its archaic format.



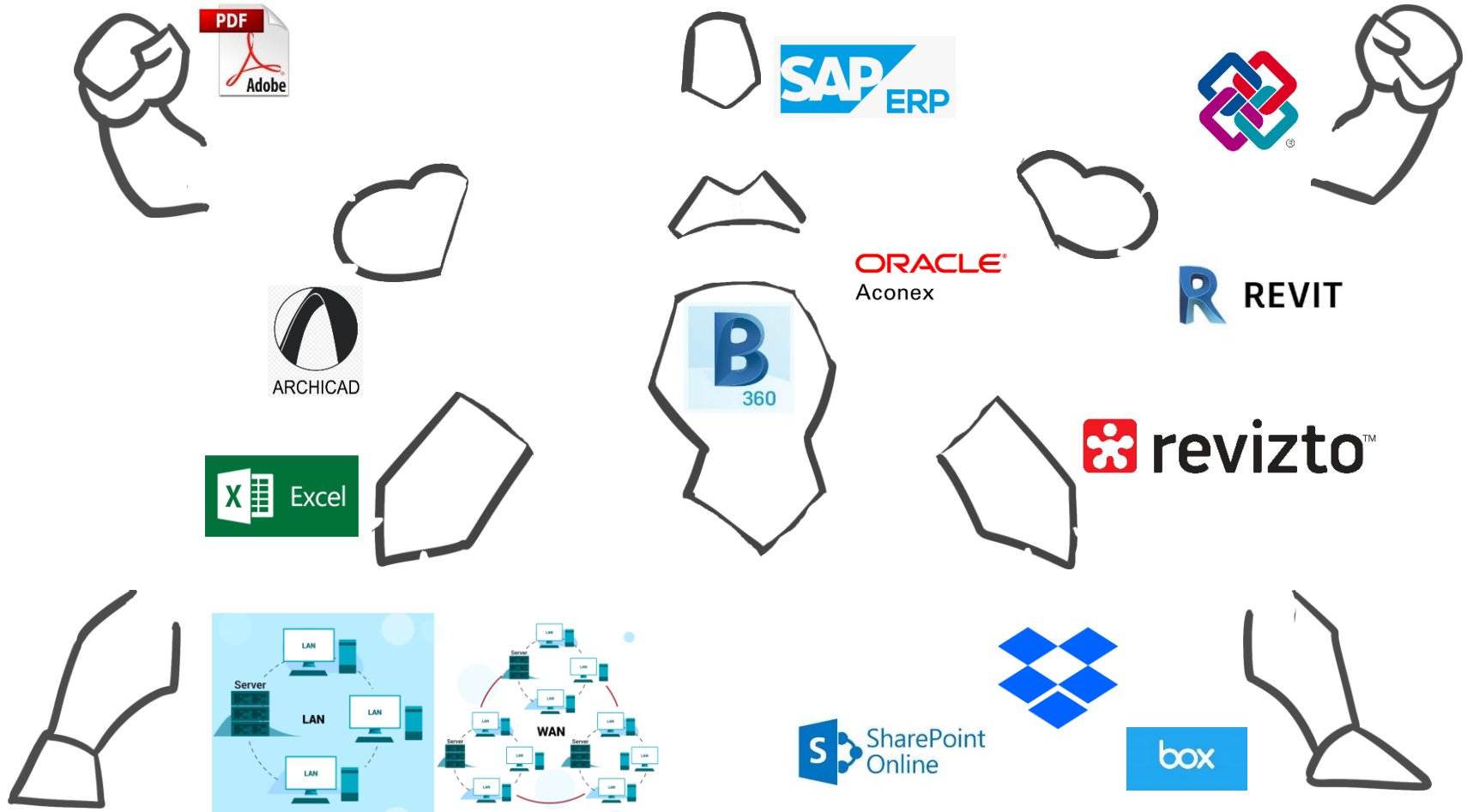
- Software obsolete (WordStar 1980s)

- Hardware obsolete (Floppy disk)

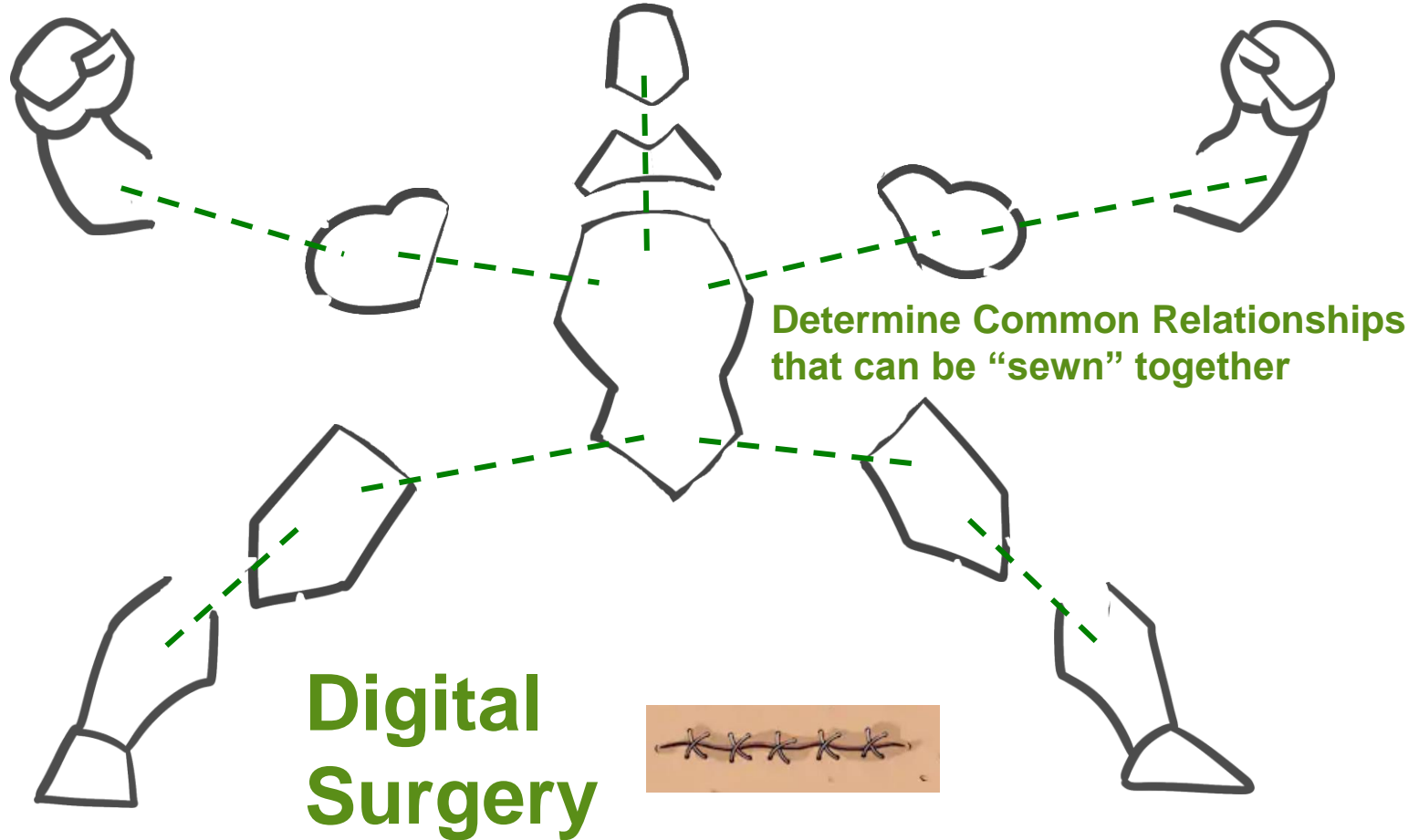
- Network, protocol, cloud obsolescence ???



The so-called “Digital Twin” Right Now



What Is Needed?



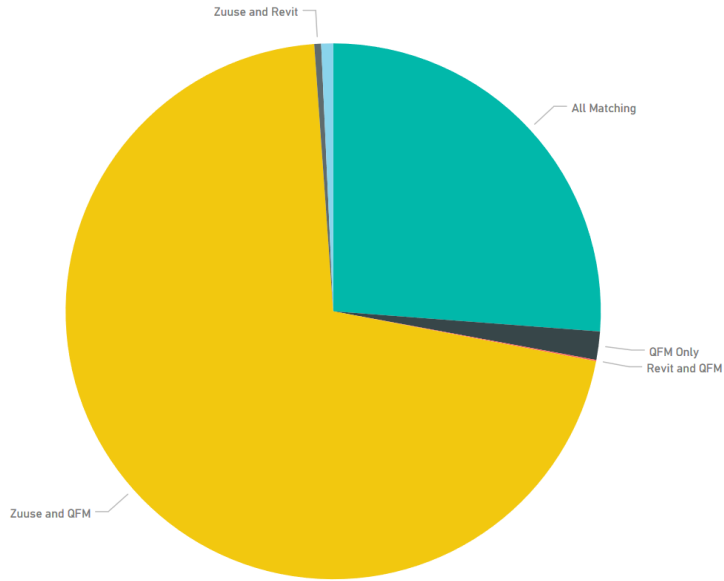
Solution: Connective Layer of Relationships



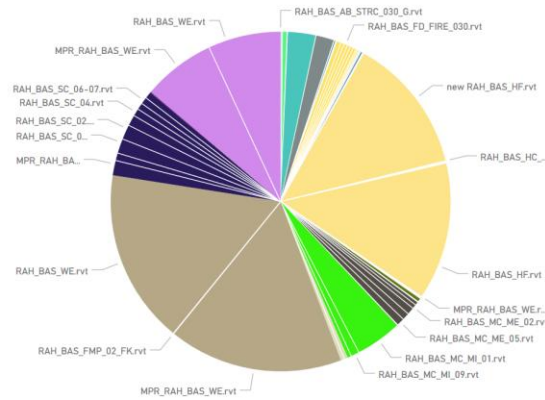
The connective covering
or post-operative layer
conceals the actual
surgical relationships...

Case Study: BIM to Site to FM Handover Process

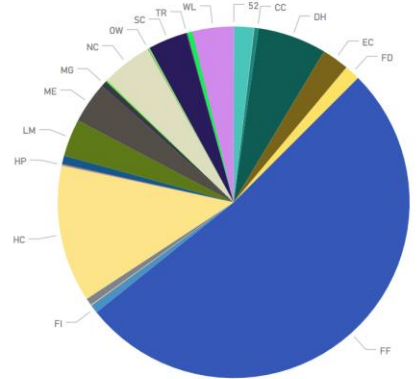
(the promise of BIM and the Digital Twin)



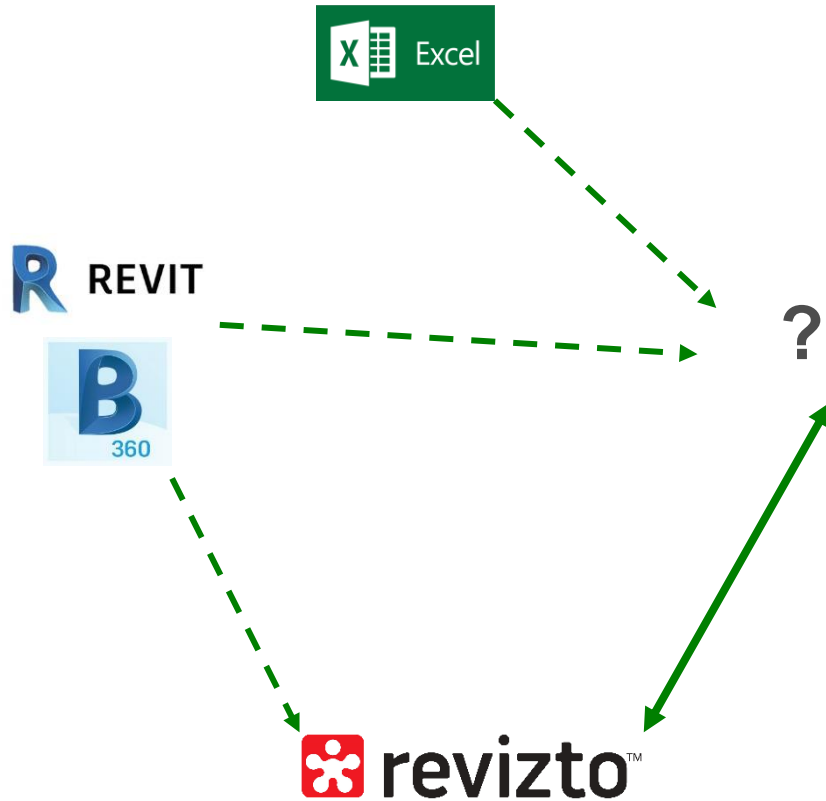
Only in Revit



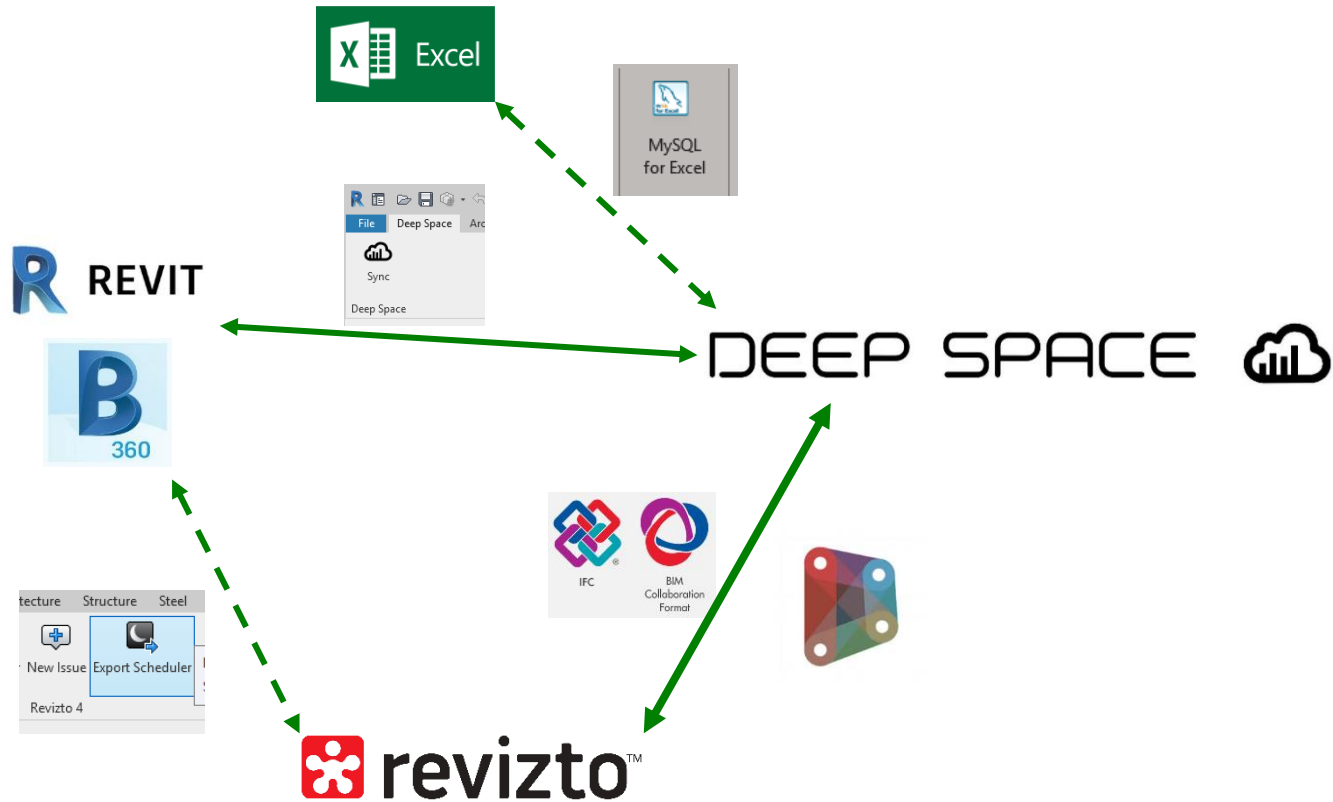
Not In Revit



Can This Be Sewn Together?



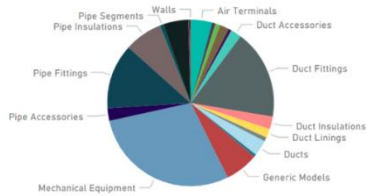
Stable Data Schema with Relationships



Data Rectification and Auditing

LM
First Pri_Abbrev
Tier 1 Mechanical Contractor (BSA)
Discipline

No Asset Code



Asset Codes

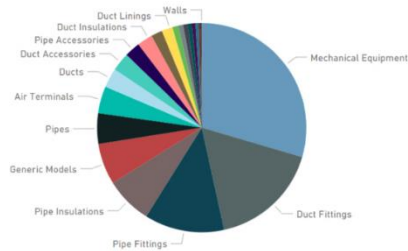
Not In Asset Register



Missing in Revit



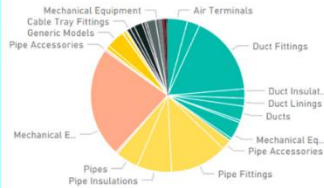
Summarise Revit Assets



Uniformat

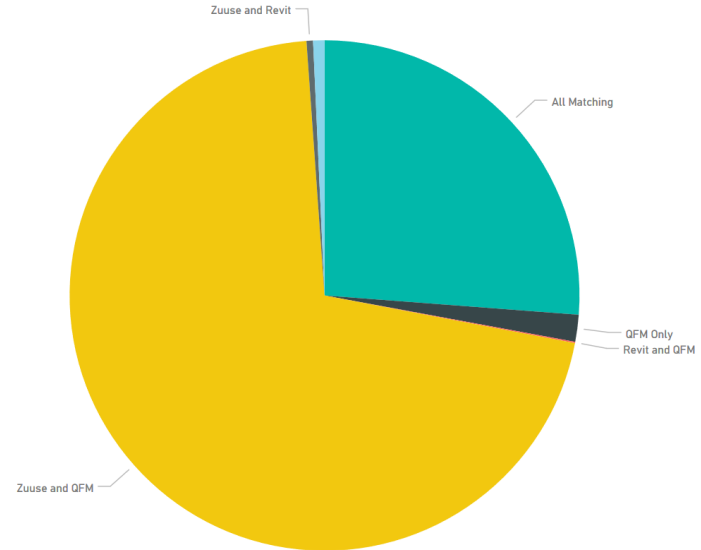
Summarise Uniformat

ParameterValue D3050.50 D3050.10 D3050.90



Missing Uniformat Values

RvtCategory	ParameterValue	Count
Air Terminals		21
Duct Accessories		134
Duct Fittings		298
Duct Linings		1
Duct Systems		1350
Ducts		5
Generic Models		6695
Mechanical Equipment		153
Pipe Fittings		84
Pipe Segments		1117
Piping Systems		552
Structural Stiffeners		152
Walls		107
Total		10669



Stable Data Schema with Relationships

FM Data Management

Filter Results:
Type: All

<input type="checkbox"/>	TABLERNAME	FRIENDLYNAME
<input type="checkbox"/>	Open...	Room Number to Wayfinding
<input type="checkbox"/>	Open...	Rooms On Sheets
<input type="checkbox"/>	Open...	DB Browser
<input type="checkbox"/>	Open...	Distribution Board Tree
<input type="checkbox"/>	Open...	Mechanical Asset Register
<input type="checkbox"/>	Open...	FM Asset Register
<input type="checkbox"/>	Open...	Asset Code Builder
<input type="checkbox"/>	Open...	VSD Schedule
<input type="checkbox"/>	Open...	FM Asset Categories
<input type="checkbox"/>	Open...	WebFM Portal
<input type="checkbox"/>	Open...	FM Asset Category List
<input type="checkbox"/>	Open...	FM Asset Register for Mining
<input type="checkbox"/>	Open...	Navisworks FM View with Srr
<input type="checkbox"/>	Open...	FM Code Filter

With Selected:

FOUND 14 RECORDS, SHOWING 30 RESULTS PER PAGE

Distribution Board Tree

Filter Results:
MSB (2) MDB (1) Dist Board (1) System Name (28)

<input type="checkbox"/>	SAPN	RAH FEEDER	RIN	RMU	MSB	WAY FINDING MSB	CB FEED	UP	WAY FINDING UPS	RISER	TOB	WAY FINDING TOB	MDB	WAY FINDING MDB	DIST BOARD	ENGINEERING NO DB	WAY FINDING DB	SYSTEM NAME	SYSTEM DESCRIP
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-3	N/A	N/A	Direct	N/A	N/A	MDB-A-1.3	1G280.03	DB-1-000-01	00.CAR.003	0A010.C1	DB-1-000-01	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-3	N/A	N/A	Direct	N/A	N/A	MDB-A-1.3	1G280.03	DB-1-000-02	01.FMM.017	1G281.01	DB-1-000-02	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-3	N/A	N/A	Direct	N/A	N/A	MDB-A-1.3	1G280.03	DB-1-011-01	01.NBD.003		DB-1-011-01	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-3	N/A	N/A	Direct	N/A	N/A	MDB-A-1.3	1G280.03	DB-1-011-02	01.NBD.002		DB-1-011-02	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-5 / MDB-A-1.5	N/A	N/A	Riser E1	N/A	N/A	MDB-1-E-020		DB-1-E-020-01	02.MH.029	2G282.01	DB-1-E-020-01	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-5 / MDB-A-1.5	N/A	N/A	Riser E1	N/A	N/A	MDB-1-E-020		DB-1-E-020-02	02.MH.138	2G280.01	DB-1-E-020-02	Distrib Board
<input type="checkbox"/>	SAPN1	HVSB1	RM1	RMU1A	MSB1A	1G280.03	A1-5 / MDB-A-1.5	N/A	N/A	Riser E1	N/A	N/A	MDB-1-E-020		DB-1-E-020-03	02.MH.012	2G284.06	DB-1-E-020-03	Distrib Board

Revizto as a Digital Twin Interface (2D, 3D, Data Link)

The screenshot displays the Revizto software interface, which serves as a digital twin interface for 2D, 3D, and data link management. The main workspace shows a 2D architectural drawing of a kitchen and corridor area. The drawing includes labels such as "KITCHEN", "CORRIDOR 01. TRA 026", and "HYD.". A yellow circle highlights a specific issue on the drawing, with a green arrow pointing from it to the "Issues" panel on the right.

The interface includes a top navigation bar with options like "Project", "Edit", "Sync", "Share", "2D", "3D", "Issue Tracker", "Docs", "Preferences", and "Help". The main workspace has a toolbar with "Go Back", "Go Forward", and navigation controls. The drawing area shows a detailed architectural plan with various annotations and dimensions.

The right sidebar contains several panels:

- Issues Panel:** Displays a list of issues with columns for "Presets", "Custom Filter", "Issues", and "Reset Filters". The list shows 179 issues, with the selected issue being ID 242, "DBE-2-010-KITCHEN-02 vbapp", reported by Luke Johnson (Spotless) and marked as "Closed".
- Chat Panel:** Shows a chat window with a search icon and a list of messages. The messages include a link to a 3D model and a status change notification: "Changed status from Open to Closed".

Revizto used to Package Modification Works

The screenshot displays the Revizto software interface. On the left, a 3D model of a room is shown with a blue callout box. The top navigation bar includes '2D', '3D', 'Issue Tracker', 'Docs', 'Preferences', and 'Help'. The main interface is divided into three panels:

- Issues Panel (Left):** A list of issues with columns for ID, status, assignee, and MW#. The issues are:
 - ID 307: Shelley Neller, In Progress, MW# 399
 - ID 309: Shelley Neller, In Progress, MW# 229
 - ID 308: Shelley Neller, In Progress, MW# 229
 - ID 306: Shelley Neller, In Progress, MW# 40
 - ID 16: hamid@draftingsol..., Solved, MW# 0326 STATE MOD - 05.IMI.042
- Chat Panel (Middle):** A chat window titled 'Chat' with a search bar and a list of messages from Will Paynter. The messages include:
 - September 6, 2019
 - 11:00 AM: Markup created
 - 11:00 AM: Changed priority from None to Minor
 - 11:00 AM: Changed assignee to Shelley Neller. Added watcher: Shelley Neller
 - 11:00 AM: Added watcher: michael.shearwood@spotless.com.au
 - 11:01 AM: Changed title
 - 11:01 AM: MW# 229 (As Built ... 2.62 MB)
- Issue Details Panel (Right):** A detailed view for issue ID 309, showing:
 - Status: In Progress
 - Title: MW# 229
 - Priority: Minor
 - Deadline: None
 - Created: 06/Sep/2019
 - Assignee: shelley@lansasolutions.com.au
 - Reporter: william.paynter@spotless.com.au
 - Watchers: 3 (michael.shearwood@spotless.com.au, shelley@lansasolutions.com.au, william.paynter@spotless.com.au)
 - Public: ON
 - Tags: 0

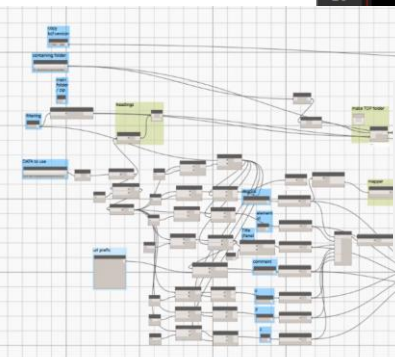
Using IfcGUID, Dynamo, BCF and Deep Space

File Explorer path: Integrations > Revit > Issue_Importer > examples from Revit > List of issues > 8c4067ea-1a24-4535-b4ba-32f2780989a5

Name	Date modified	Type	Size
markup.bcf	26/08/19 2:21 PM	BCF File	2 KB
snapshot.png	26/08/19 2:21 PM	PNG File	1,397 KB
viewpoint.bcfv	26/08/19 2:21 PM	BCFV File	2 KB

```
<?xml version="1.0" encoding="utf-8"?>
<Markup xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
  <Header />
  <Topic Guid="8c4067ea-1a24-4535-b4ba-32f2780989a5" TopicState="None" >
    <Title>DB-2-010-02</Title>
    <Priority>None</Priority>
    <CreationDate>2019-05-24T00:05:39Z</CreationDate>
    <CreationAuthor>ljohnson@virtualbuilt.com.au</CreationAuthor>
    <ModifiedDate>2019-08-26T04:49:43.5397931Z</ModifiedDate>
    <AssignedTo>ljohnson@virtualbuilt.com.au</AssignedTo>
  </Topic>
  <Comment Guid="ce486453-6086-4bd2-b8b9-da3d9ab26724" >
    <Date>2019-05-24T00:47:09Z</Date>
    <Author>ljohnson@virtualbuilt.com.au</Author>
    <Comment>https://www.virtualbuiltapp.com/apps/app_rah/index.html
  </Comment>
  <Viewpoint Guid="2c424dd-c8a1-4f79-11a2-5073b9cf60ff" >
    <ViewpointType>2c424dd-c8a1-4f79-11a2-5073b9cf60ff</ViewpointType>
  </Viewpoint>
  <Viewpoint Guid="viewpoint.bcfv/Viewpoint" >
    <ViewpointType>viewpoint.bcfv</ViewpointType>
  </Viewpoint>
</Markup>
```

```
<?xml version="1.0" encoding="utf-8"?>
<VisualizationInfo xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" >
  <Components >
    <ViewSetupHints SpacesVisible="true" SpaceBoundariesVisible="true" >
      <Selection >
        <Component IfcGuid="30vGhD$xf54hipU8R9nTUb">
          <AuthoringToolId>1684836</AuthoringToolId>
        </Component>
      </Selection>
      <Visibility DefaultVisibility="true">
        <Exceptions />
      </Visibility>
      <Coloring />
    </Components>
    <PerspectiveCamera >
      <CameraViewPoint >
        <X>-191.5383575918259</X>
        <Y>118.62003545038624</Y>
      </CameraViewPoint>
    </PerspectiveCamera>
  </ViewSetupHints>
</VisualizationInfo>
```



RvtGuid	RvtName	ParameterValue	revitio_project_id	R_ProjectName	RvtElementId	ifcguid	RvtPosX	RvtPosY	RvtPosZ
4acbf00e-5237-4be9-b829-b1fb6af0e5a6-0013...	RAH BAS EC 010.rvt	DBE-3-010-02	51845	Level 0 & 1	1261005	1Aa50EKZTBwRwfvOvuuz0h	-150035.577602000000	226257.536710000000	25600.000000000000
4acbf00e-5237-4be9-b829-b1fb6af0e5a6-0013...	RAH BAS EC 010.rvt	DB-3-010-02	51845	Level 0 & 1	1261013	1Aa50EKZTBwRwfvOvuuz0a	-151082.077602000000	226257.536710000000	25600.000000000000
52756d2d-8179-4e2c-877b-cb9fc7de706-0019...	RAH BAS EC 010.rvt	DBE-2-010-04	51845	Level 0 & 1	1676339	1ITMarWNBEB8TxwSd7v7Cr	-176900.077602000000	211255.638048000000	25600.000000000000
61c2d68f-c002-44ba-8db9-4368746a1571-001...	RAH BAS EC 010.rvt	DBE-2-010-06	51845	Level 0 & 1	1677020	1XmiOFm094resvGaXaSuEi	-218657.577602000000	211446.632764000000	25600.000000000000
61c2d68f-c002-44ba-8db9-4368746a1571-001...	RAH BAS EC 010.rvt	DB-2-010-05	51845	Level 0 & 1	1677162	1XmiOFm094resvGaXaSuBR	-213638.577602000000	197357.036710000000	25600.000000000000
61c2d68f-c002-44ba-8db9-4368746a1571-001...	RAH BAS EC 010.rvt	DBE-2-010-05	51845	Level 0 & 1	1677266	1XmiOFm094resvGaXaSuA7	-213638.577602000000	198134.636710000000	25600.000000000000

You are here: FM Data Management :: List

FM Data Management

Filter Results:
Type:

<input type="checkbox"/>	TABLERNAME	FRIENDLYNAME	TABLEDETAILS	TYPE
<input type="checkbox"/>	Open...	Room Number to Wayfinding Map	Table that shows Revit Room Number relationship to...	Input
<input type="checkbox"/>	Open...	Rooms On Sheets	Allows searching between rooms and sheets	View
<input type="checkbox"/>	Open...	DB Browser	Joined view of DB data from Revit, VSD, Mech, DB T...	View
<input type="checkbox"/>	Open...	Distribution Board Tree	Distribution Board Tree	Import
<input type="checkbox"/>	Open...	Mechanical Asset Register	Asset Register for Tier 2 Mechanical	Import
<input type="checkbox"/>	Open...	FM Asset Register	View fm data	Import
<input type="checkbox"/>	Open...	Asset Code Builder	Generator for asset codes from elements, spatial...	View
<input type="checkbox"/>	Open...	VSD Schedule	VSD Schedule	Import
<input type="checkbox"/>	Open...	FM Asset Categories	FM Asset Categories	Input
<input type="checkbox"/>	Open...	WebFM Portal	WebFM data	Import
<input type="checkbox"/>	Open...	FM Asset Category List	List of Categories where Asset Data is required	Input
<input type="checkbox"/>	Open...	FM Asset Register for Mining View	FM Asset Register for Mining	View
<input type="checkbox"/>	Open...	Navisworks FM View with SmartPlant 3D	Navisworks FM View with SmartPlant 3D	View
<input type="checkbox"/>	Open...	FM Code Filter	Filter view of FM data	View

With Selected:
 Update Copy

FOUND 14 RECORDS. SHOWING 30 RESULTS PER PAGE

[RSS](#)
[Export CSV](#)

- #### Navigation
- VDC Manager
 - Insights
 - BIM Manager
 - VDC Data
 - VDC Views
 - Architect
 - Cloud
 - Files
 - Quick Links
 - Model Tracker
 - Tracker Menu
 - Work
 - 3D Coordination
 - 4D Programme
 - Model Compare
 - Auditing
 - Spatial
 - FM**
 - AIM
 - Classification
 - Integrations
 - Settings



BIM-FM Lessons

- Clear + Validated Handovers
- Choose a platform early + stick with it

- Determine 'minimum data requirements'
 - ↳ validate / audit
 - ↳ enforce rectification

Stable Data Schema for Lifecycle

DEEP SPACE

You are here: [Dashboards](#) :: [Parameter Report \(work in progress\)](#) :: View

This Record
• [Role](#)

Navigation

- [Overview](#)
- [Project](#)
- [Cloud](#)
- [Quick Links](#)
- [Model Tracker](#)
- [TrackerViews](#)
- [Dashboards](#)
- [Project Teams](#)
- [Work](#)
- [BIM Standards](#)
- [Coordination](#)
- [Model Compare](#)
- [Auditing](#)
- [BIM Data](#)

Dashboards Show All

Parameter Report (work in progress)

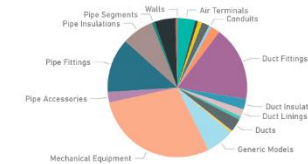
View [Role](#) Edit RSS Delete Copy Set Update Set

Parameter Report (work in progress)

Main Dashboard


LM
First Pri_Abbrev

Tier 1 Mechanical Contractor (BSA)
Discipline




Asset Codes

Not In Asset Register



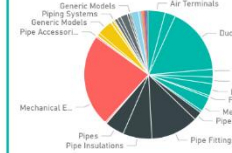
Missing In Revit



Uniformat

Summarise Uniformat

ParameterValue ● D3950.50 ● D3050.10 ● D3050.90 ●

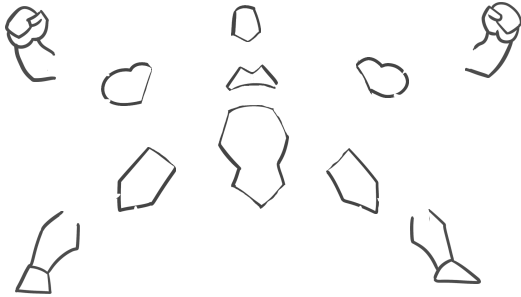


Missing Uniformat Values

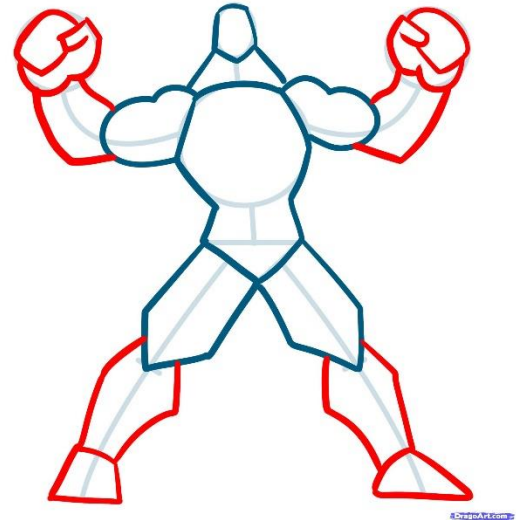
RvtCategory	ParameterValue	Count
Air Terminals		21
Duct Accessories		134
Duct Fittings		298
Duct Linings		1
Duct Systems		1350
Ducts		5
Generic Models		6695
Mechanical Equipment		143

- custom schema
- automated
- live
- mobile

The Digital Twin is Aspirational... and that's OK

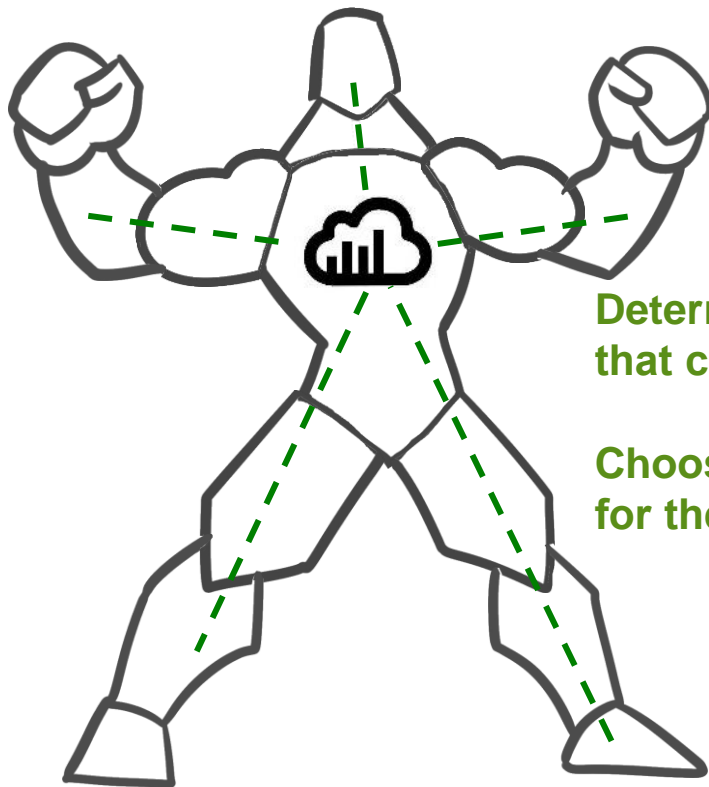


Start surgery on your
Digital Twin now



[dreamstime.com](https://www.dreamstime.com/stock-vector-artwork-image/stock-vector-artwork-image-image123456789.html)

Choose a Platform That Enables Data Relationships



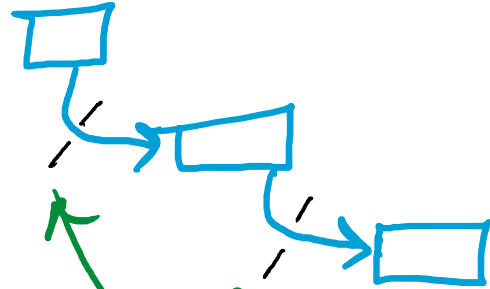
**Determine Common Relationships
that can be “sewn” together**

**Choose a Framework that allows
for the Surgery to take place...**

So What... Now What?



“If we learn from our mistakes, shouldn’t I try to make as many mistakes as possible?”



Modify your workflows based on what you learn

Questions?

Presented by:

Luke Johnson

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[Deep Space Sync](#)

<https://www.deepspacesync.com/>

[What Revit Wants](#)

<https://wrw.is/>

[Virtual Built](#)

ljohnson@virtualbuilt.com.au