BIM Software - A Comparative Analysis

Part of the MCAA's Construction Technology Research Series

Performed by

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Committee Chairman's Note

MCAA Construction Technology Committee's Chairman Note
BIM Software Research Report

When the MCAA Construction Technology Committee developed the idea of the *Construction Technology Research Series*, a lot of the initial spark was centered on Building Information Modeling (BIM) software. For contractors that have not begun down the BIM path, getting started can be a daunting view. You need to consider how to adjust your operations, find personnel capable of doing the work, buy high-end computer workstations and evaluate which software is the best fit for your company. The goal of this research study is to at least help out with that last piece.

For contractors with established BIM or VDC departments, I think this research report will prove useful as well. We often follow the path we chose years ago because the difficult process that comes with change is a heavy tax on our businesses. It would be irresponsible not to look around though. If we want to continue to be at the forefront, it takes work to stay ahead. Every year products evolve and there are new dimensions and features to make processes easier. To compete, we need to know what is out there, what makes a difference and if the expense is justifiable.

The most difficult part of this report is that software is continually changing and being released while still in development. Even the most established software platforms have important features that are only half built or are in the process of being merged from acquired. **This research report is only a snapshot of the software out there as it exists right now**. Six months from now, there will be distinct changes and new products available. Please consider that when you look at any and all software. It is important to understand where the software is right now, what features are going to be added and when they will be available. Ask questions when you talk to vendors and understand the development side of software. It can be frustrating, but you need to make sure that features you are buying software for are fully developed and incorporated.

Brian Helm, President, Mechanical Inc., Freeport, Illinois
Chairman, MCAA Construction Technology Committee

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What is this report about?

MCAA's Construction Technology Research Series

Members of the MCAA stand to greatly benefit from the rapidly evolving technologies in the space of construction and maintenance that can expedite work, increase precision, and prevent mistakes. The MCAA's Construction Technology Research Series explores scanning, tracking, layout, design, and fabrication technologies using BIM and other tools to explore their potential value to the MCAA.

Report abstract

This section of the research project is a canvas of *BIM model creation software with a focus on MEP*. Included is an assessment of various BIM software for BIM model authoring, model review, construction management, and analysis software tools in the context of mechanical contractors.

Who made this report?

This report was written by JBKLabs, the research and development team of JBKnowledge, Inc.

Focus on readily-available technology

This study focuses on technology that is available for practical use at the time of writing. Any technology that was deemed too bleeding-edge for practical use is included in the **What's next?** section at the end of this report.

How this research was conducted

The research in this study was conducted through a combination of hands-on analysis of tools and interviews with industry experts. We focused on sharing industry expert knowledge to make sure our tool analyses were accurate.

What is BIM?

BIM is Building Information Modeling. BIM models are databases that represent the physical and functional characteristics of a place. BIM can be thought of in a number of dimensions:

- **3D BIM**: the 3-dimensional characteristics of a space (the 3D model)
- **4D BIM**: time is introduced, so the 3-dimensional representation of the space can be observed through time
- **5D BIM**: cost is introduced, so cost of materials can be observed through time
- **6D BIM**: as-built is introduced, so the state of the space after construction is completed is represented, including maintenance, operation, specifications, photos, warranty data, etc

BIM adoption

BIM has already become a critical component of the construction process. Between layout, QA/QC, and as-builting, BIM expedites project completion and significantly cuts costs. In 2014, three quarters of construction firms reported a positive ROI on their BIM program investments, and a majority reported a reduction in errors and omissions on work done[1]. With an expectation that contractors' BIM-related work will increase by 25% a year, the time to seriously adopt BIM is now[2].

[1] Bernstein, *The Business Value of BIM for Construction in Major Global Markets*, 1.
[2] Ibim.

What are the primary use cases for BIM?

Authoring

Authoring tools are used to create the 3D model of the building. The 3D model can consist of components that are cataloged to correspond with real items, so they may have a cost, part name, or other metadata attached. The Level of Detail, or LOD, is used to specify how fine-grained the 3D model was constructed.

Level of Detail (LOD)

LOD 100	For cost per area and total project construction duration
LOD 200	3D, but generic models; exterior systems selected
LOD 300	Construction means and methods; dimensions, capacities and connections; clash coordination
LOD 400	Shop drawings and fabrication details; purchase prices of assemblies
LOD 500	As-built or record model for facility operations and maintenance

Construction management

Beyond the design stage, BIM can be used for construction management throughout the building process. 4D simulation, clash detection, cost and quantity feedback, fabrication, reporting, and facility management software suites can allow BIM to be the basis by which construction is managed and provide a more stable and readily accessible set of resources than traditional methods.

Model review

Model review software can be used to transition software between different platforms (interoperability), to combine design and construction data in one view, to make measurements, and to detect and coordinate to resolve clashes.

Model analysis

Model analysis software can be used to predict real-world performance of models. Energy, mechanical systems, HVAC systems, and more can be simulated to determine if the modeled building will perform well when built.

Macro BIM compared to Micro BIM

There are two different types of BIM solutions available that address user's needs in very different ways. Macro BIM solutions are built using elements focused on specific BIM outputs including cost, time, coordination, analysis, and communication. Macro BIMs are intended to be built quickly, facilitating rapid analysis of multiple concepts or ideas prior to launching into a more detailed study of a preferred concept using Micro BIM applications. Micro BIM solutions require more model accuracy and specific components to generate outputs. Micro BIM solutions require users to consider multiple factors like documentation, sizing, constructability, and numerous other real-world conditions for coordination, estimates, schedules, and facilities management. Synchro Pro is the only Macro BIM tool reviewed in this report.

MCAA WebLEM database

The MCAA provides its members with WebLEM, a web-based labor estimating database, available at www.weblem.org.

The Labor Units covered by the WebLEM database are:

- Branch Connections
- Cleanroom Piping & Procedures
- Excavation & Backfill
- Fittings
- Flanges
- Hangers, Sleeves & Inserts
- HVAC Equipment
- HVAC Hook-Ups
- HVAC Specialties
- Instrumentation
- Miscellaneous Labor Operations
- Nipples
- Pipe
- Plumbing Equipment
- Plumbing Fixtures
- Plumbing Hook-Ups
- Plumbing Specialties
- Refrigeration Equipment
- Refrigeration Specialties
- Treatment Plant Equipment
- Valves

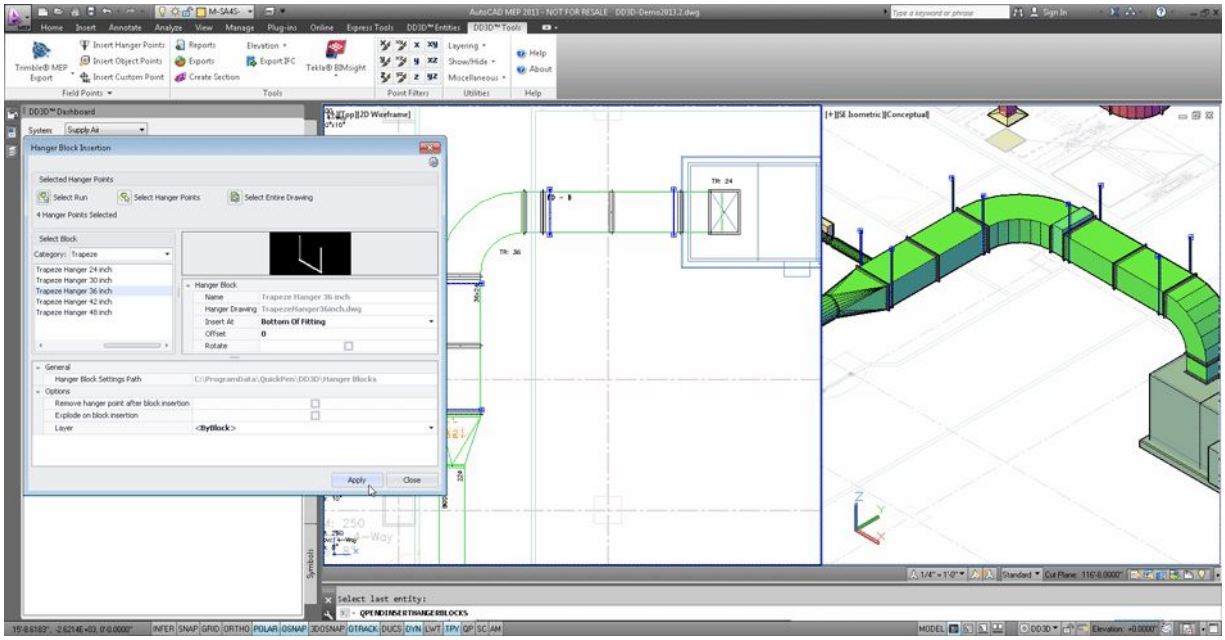
The WebLEM database is already incorporated into multiple estimating platforms including Autobid Mechanical, Quotesoft,, and ESTmep which have connections to multiple BIM authoring tools which we have highlighted in this report. Fabrication CADmep and SysQue have incorporated all this data directly into their BIM items and families.

Evaluations

Please note that the evaluations in this report are focused on *BIM model creation*. The next report published will cover software for *BIM to field model distribution*.

Authoring Software

Trimble Duct Designer 3D

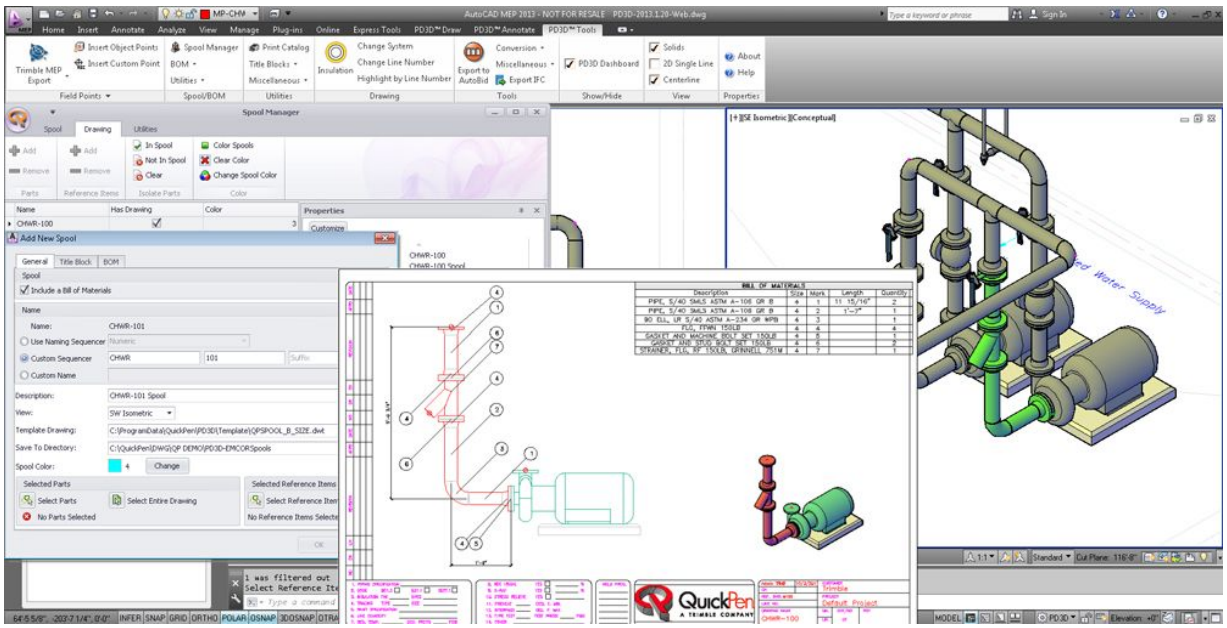


Automatic insertion of hanger blocks in Trimble Duct Designer (image by Trimble).

Use case	(Formerly known as QuickPen) CAD detailing software for sheet metal and HVAC
Vendor	Trimble
Cost	Not available
Compatibility	AutoCAD, Tekla BIMsight, Trimble AutoBid Sheet Metal, Vulcan CAM, Trimble Field Link for MEP, Trimble MEP, Navisworks
Pros	Built on top of AutoCAD to simplify the learning curve for those transitioning from 2D CAD. SMACNA rules built into solution. Much easier to manipulate the UCS (user coordinate system)

	than in AutoCAD. Easily connects to Trimble MEP, BIMsight, Vulcan and other Trimble technology to add functionality. UA teaches DD & PD in their programs making it easy to find users with experience.
Cons	When exporting models to Navisworks and other model review solutions limited data is translated and geometry is generic.
Learning curve	Simple learning curve. Designed for users not fully schooled in CAD to learn quickly.
Conclusion	Duct Designer 3D allows users to easily transition from 2D CAD to BIM. It is built on top of the AutoCAD engine minimizing user's learning curve. The tool gives users the ability to import and export with Trimble AutoBID for estimating, Vulcan for fabrication, and Trimble MEP for field layout providing users with a wide range of capabilities. Duct Designer 3D is part of a larger portfolio of products offered by Trimble that allows users to add functionality incrementally.

Trimble Pipe Designer 3D

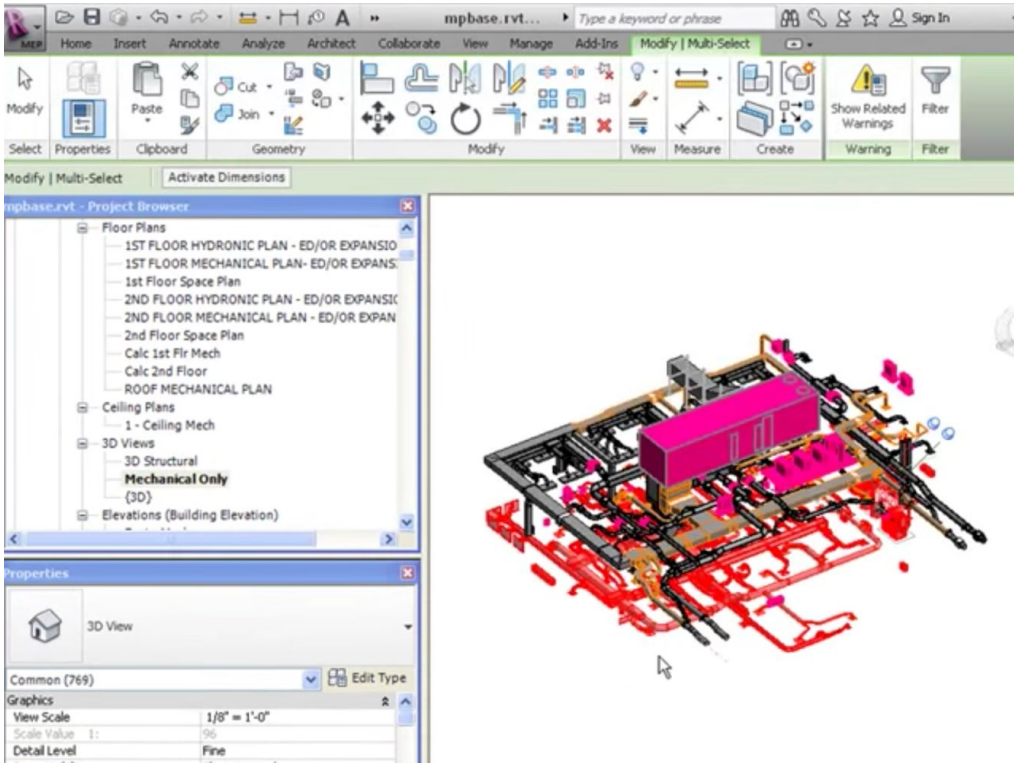


Creating a spool with Trimble Pipe Designer (image by Trimble).

Use case	(Formerly known as QuickPen) CAD detailing software for mechanical, piping, and plumbing
Vendor	Trimble
Cost	Not available
Compatibility	Tekla BIMsight, Trimble AutoBid Mechanical, Trimble Field Link for MEP, Trimble MEP, Navisworks
Pros	Built on the AutoCAD engine, which helps minimize learning curve. All content is free and available to everyone. Integration with Trimble Connect simplifies the field verification process enhancing communication between the fab shop and field. Strong connection with other Trimble products making it easy to get data to the field.
Cons	Limited manufacturer specific content. HPH cost and data not built into system. When exporting models to Navisworks and

	other model review solutions limited data is translated and geometry is generic.
Learning curve	Very easy to learn. Users transitioning from 2D CAD have a minimal learning curve.
Conclusion	Pipe Designer 3D allows users to easily transition from AutoCAD to BIM. The tool gives users the ability to import and export with Trimble AutoBID for estimating, and Trimble MEP for field layout providing users with a wide range of capabilities. Pipe Designer 3D is part of a larger portfolio of products that allows users to incrementally add functionality. Users of PD 3D can generate spool sheets and bill of materials within the software. The one main limitation is when users export their models for coordination or other BIM deliverables.

East Coast - MEP Design to Fabrication

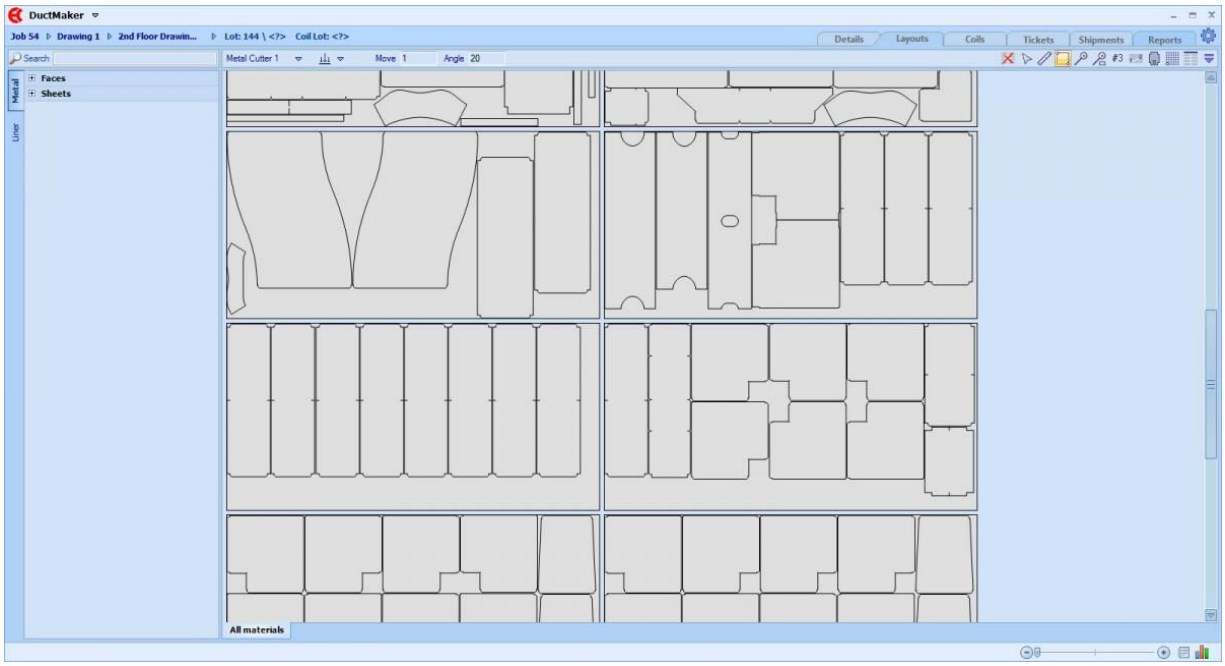


Inspecting mechanical only 3D view in East Coast - MEP Design to Fabrication (image by East Coast).

Use case	A complete design and prefabrication solution for contractors and fabricators who create and install piping.
Vendor	Trimble
Cost	Not available
Compatibility	Built on AutoCAD MEP, Strong integration with Revit. Connection with Vicon, Vulcan, QuoteSoft, Viewpoint, and Trimble Connect.
Pros	EC-CAD provides users a streamlined workflow that supports bringing in Revit models created by engineers and quickly converts these into spec-driven models that allows users to efficiently generate spool sheets directly from the model.

	Supports automatic tagging and dimensioning of pipe in isometric views. Automatically generates accurate bill of materials. A significant amount manufacturer content is built into EC properties.
Cons	Does not have HPH data built into properties out of the box.
Learning curve	Intermediate
Conclusion	MEP Design to Fabrication allows users to leverage design models produced in Revit and quickly convert these into detailed fabrication level models. MEP Design to Fabrication enables a workflow that minimizes rework and reduces the overall time it takes to generate estimates and spooling drawings.

East Coast - DuctMaker

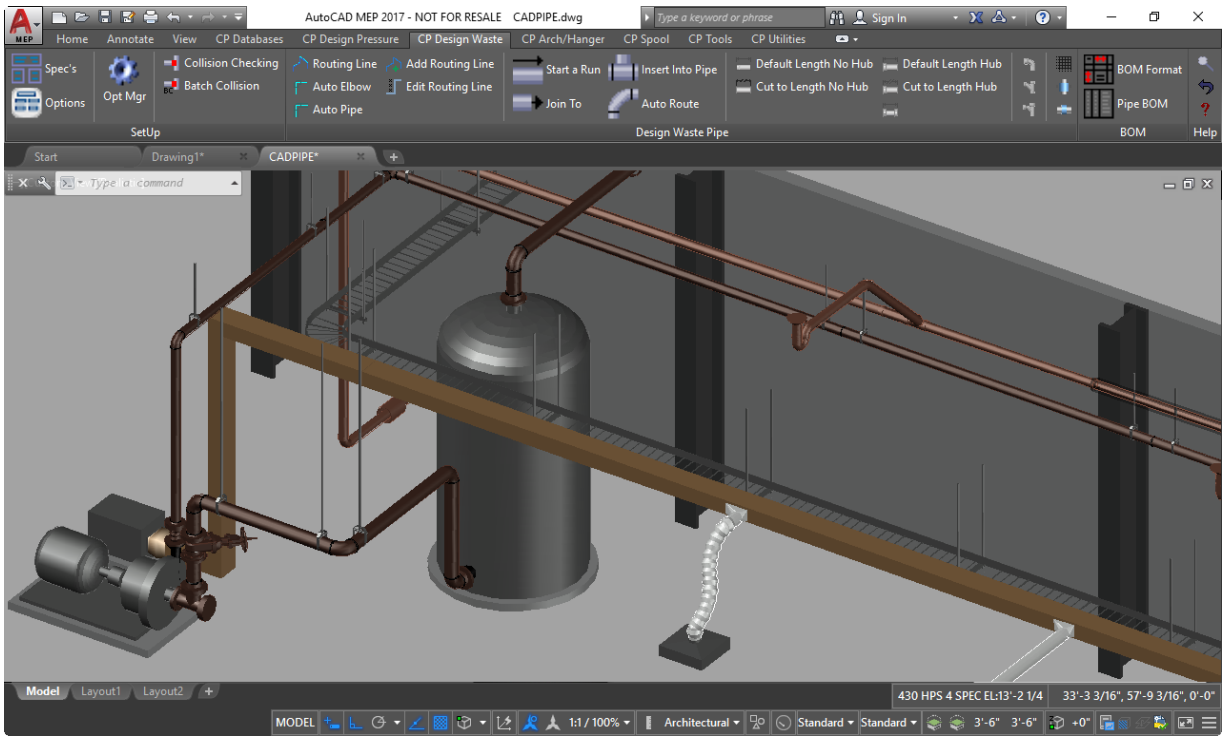


Nesting with EC-DuctMaker (image by Trimble).

Use case	A complete design and prefabrication solution for contractors and fabricators who create and install piping.
Vendor	Trimble
Cost	Not available
Compatibility	Built on AutoCAD MEP, Integrated workflows with Revit. Connection with Vicon, Vulcan, QuoteSoft, Viewpoint, and Trimble Connect.
Pros	Industry standard manufacturer default dimensions, allowances, and specifications for gauges, connectors, and more are built right into the software. DuctMaker can accept drawings directly from AutoCAD MEP, and works closely with EC-CAD to simplify interoperation, sharing the same library of fittings, rule sets, and dimensioning behaviors. That means your project team can quickly go from design to fabrication. Layout Editor lets you

	drag, drop, and rotate fittings, perform collision checking to prevent overlap, and lock down the design.
Cons	Limited compatibility with ITM files in CADmep and CAMDuct
Learning curve	Intermediate
Conclusion	DuctMaker allows users to convert design models produced in Revit and other BIM solutions into fabrication level models. DuctMaker enables a workflow that minimizes rework and reduces the time it take to go from design to fabrication. Support workflows that allows users to export duct models to Revit. Optimized nesting enables users to minimize waste.

CADPIPE - Commercial Piping - Modeling to Fabrication

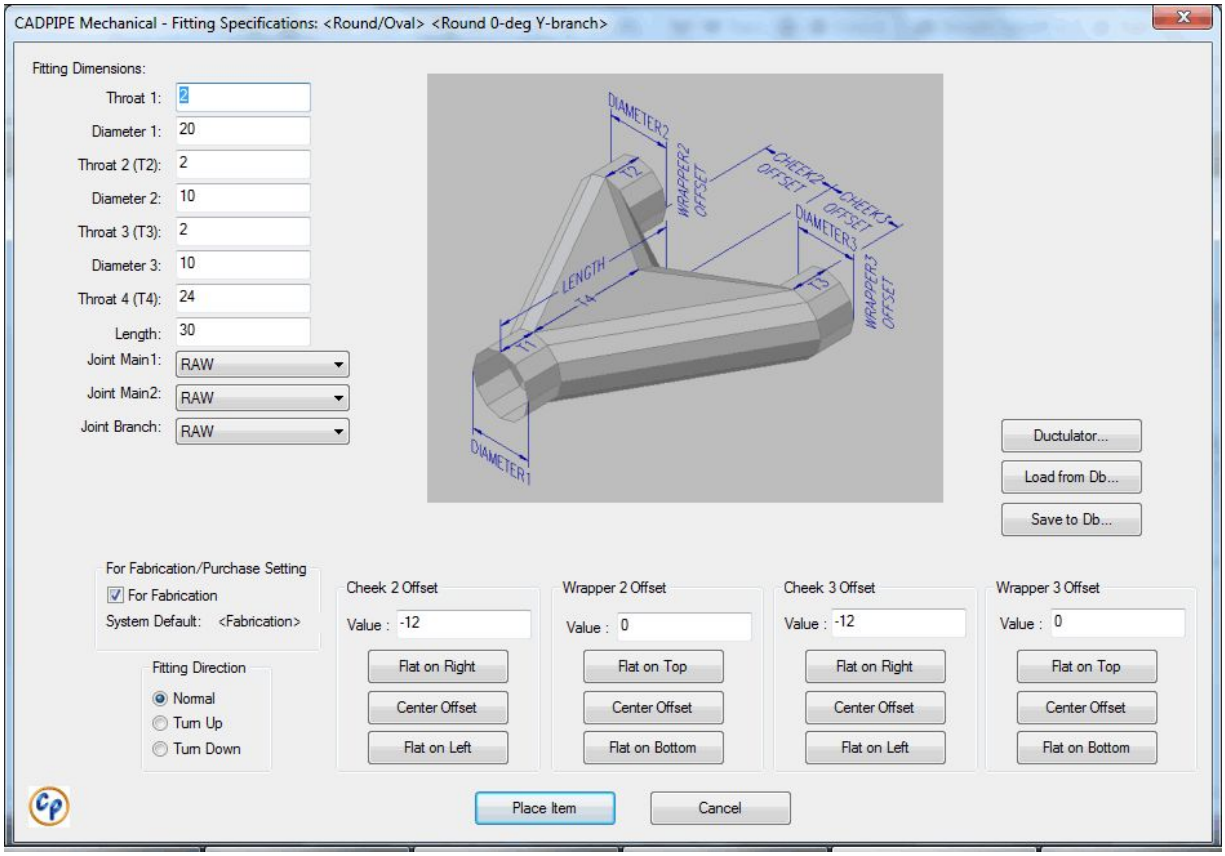


Designing waste pipe in CADPIPE on AutoCAD MEP 2016 (image by CADPIPE).

Use case	Create fabrication levels models of pressure pipe, waste pipe, and copper tubing.
Vendor	Orange Technologies
Cost	$5000 per license
Compatibility	Outputs hanger and sleeve locations to Trimble Total Stations and GTP services. Attributes compatible with Navisworks. Vicon and Vulcan Plasma Table and Coil Line downloads.
Pros	Features like Dynamic Auto-Route allow users to easily create and edit modeled pipe. Commercial Piping allows users to customize preferences relating to dimensions, systems, sheets, and more to help users maximize productivity. CADPIPE has the ability to optimize cut pipe which finds all fittings to minimize waste and produce reports. One of the most cost effective MEP

	authoring solutions. CADPIPE provide tools that allows uses to model ceilings, lights, steel, columns, and more for coordination purposes.
Cons	Limited manufacturer content and HPH data not connected to properties.
Learning curve	Intermediate
Conclusion	CADPIPE Commercial Piping has been in use for over 25 years and provides users the ability to create fabrication level models. Users have the ability to create spool sheets directly from the model generating an accurate bill of materials along with features like automatically tagging and dimensioning the isometric views. CADPIPE also support exports to total station to streamline hanger placement in the field.

CADPIPE Mechanical

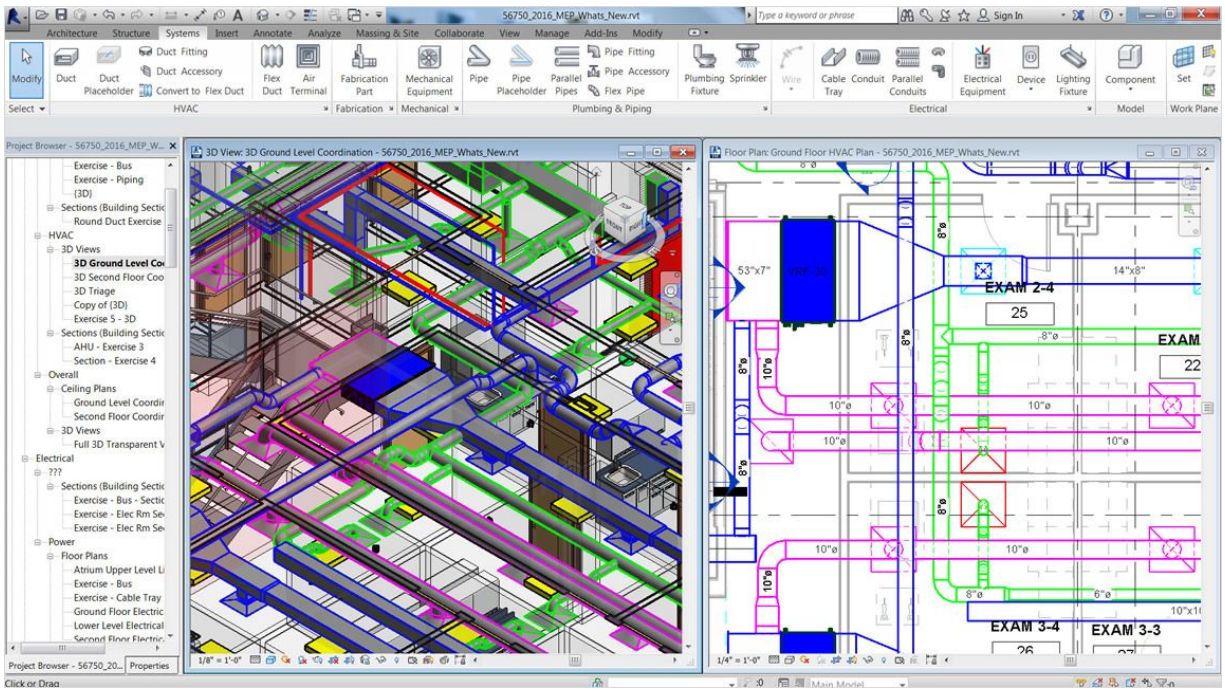


Building a Y branch in CADPIPE Mechanical (image by CADPIPE).

Use case	Create fabrication levels models using SMACNA standards.
Vendor	Orange Technologies
Cost	$4000 - $5000
Compatibility	CADPIPE Mechanical attributes can be viewed within Navisworks. Vicon and Vulcan Plasma Table and Coil Line downloads.
Pros	Features like Dynamic Auto-Route and Dynamic move allow users to easily and accurately edit modeled duct. Hanger locations are automatically placed when modeling using

	customizable rules. Hanger placement also exports directly to total station.
Cons	Limited manufacturer content and HPH data not connected to properties.
Learning curve	Intermediate
Conclusion	CADPIPE Commercial Piping has been in use for over 25 years and provides users the ability to create fabrication level models. Users have the ability to create spool sheets directly from the model generating an accurate bill of materials along with features like automatically tagging and dimensioning the isometric views. CADPIPE also support exports to total station to streamline hanger placement in the field.

Revit

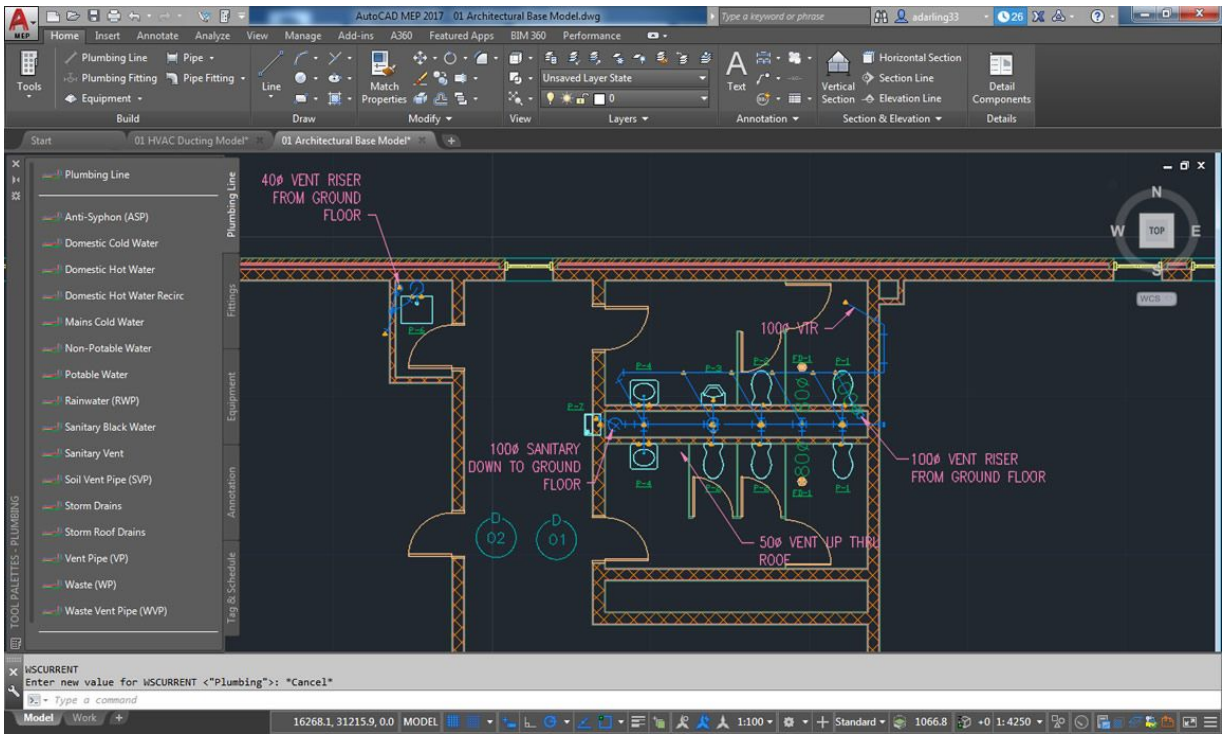


Using Revit to design and document HVAC (image by Autodesk).

Use case	BIM for MEP Designers / Engineers
Vendor	Autodesk
Cost	$2,310
Compatibility	Connection with Fabrication CADmep, ESTmep and CAMduct through ITM files. Ability to export IFC and DWG file types. Streamlined integration with Navisworks.
Pros	Autodesk is investing a great deal into the Revit platform. A lot of improvements in 2017 with connections to Fabrication suite of tools. The product has a plethora of Add-ins that provides users with additional functionality and features on top of an already powerful tool.
Cons	Creating and managing complex families requires time and effort for experienced users. Revit is more focused on

	workflows that align with designers than detailing out of the box.
Learning curve	Complex learning curve for those transitioning from 2D CAD. Intermediate level learning curve for users transitioning from other BIM solutions.
Conclusion	Revit is synonymous with the term BIM. The number of Add-ins, families and tools built on top of Revit are growing quickly. Some owners are requesting RVT files as a deliverable due to their growing interest in managing facilities and leveraging data populated in models. The use of Revit will continue to grow but their are limitations with the product when it comes to producing MEP fabrication level models out of the box today. Solutions like SysQue and Victaulic are helping bridge the gap in the product today. The recent developments with CADmep ITM content has greatly enhanced user's' ability to model MEP systems in Revit.

AutoCAD MEP

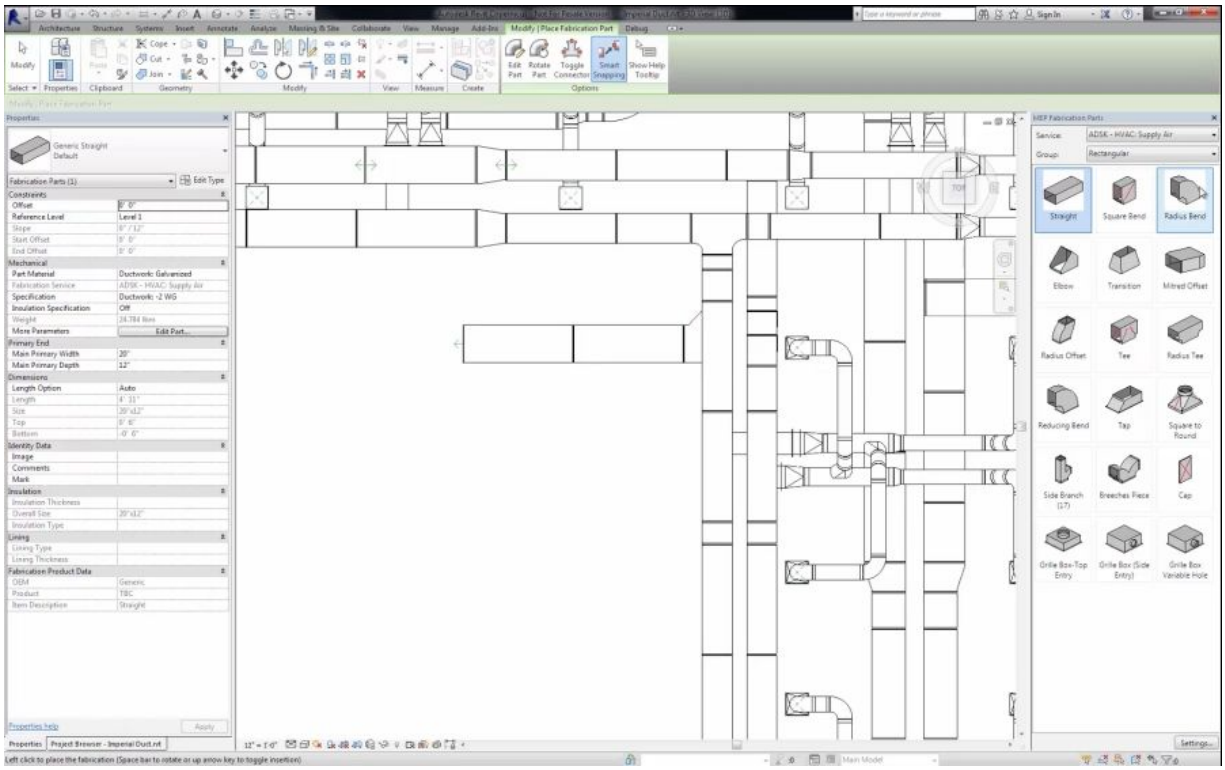


Working with flat 2D floor plans in AutoCAD MEP (image by Autodesk).

Use case	Flexible solution used by both MEP designers and detailers.
Vendor	Autodesk
Cost	$2,100
Compatibility	DWG is still the industry standard when it comes to file formats. AutoCAD MEP is the engine for numerous other BIM solutions. Compatible with Navisworks.
Pros	Most detailers in the industry today have experience with AutoCAD MEP. Straight forward learning curve and can help bridge the learning curve into other BIM solutions. There are multiple tools that are built on top of AutoCAD MEP that address limitations. Many design engineers are still using AutoCAD MEP so traditional workflows are comfortable.

Cons	Autodesk continues to support AutoCAD MEP but has discontinued further development of the product. There are modeling limitations when compared to other BIM tools. Autodesk is shifting focus to Fabrication CADmep, CAMduct, ESTmep, and Revit MEP.
Learning curve	Easy to learn. Most industry professionals have experience with AutoCAD MEP.
Conclusion	Autodesk MEP is still the most popular solution for professionals focused on MEP design and detailing. Other solution providers (software vendors) have expanded upon the base features to provide users with more robust features that address users needs for fabrication, estimating, and editing/changing models.

CADmep

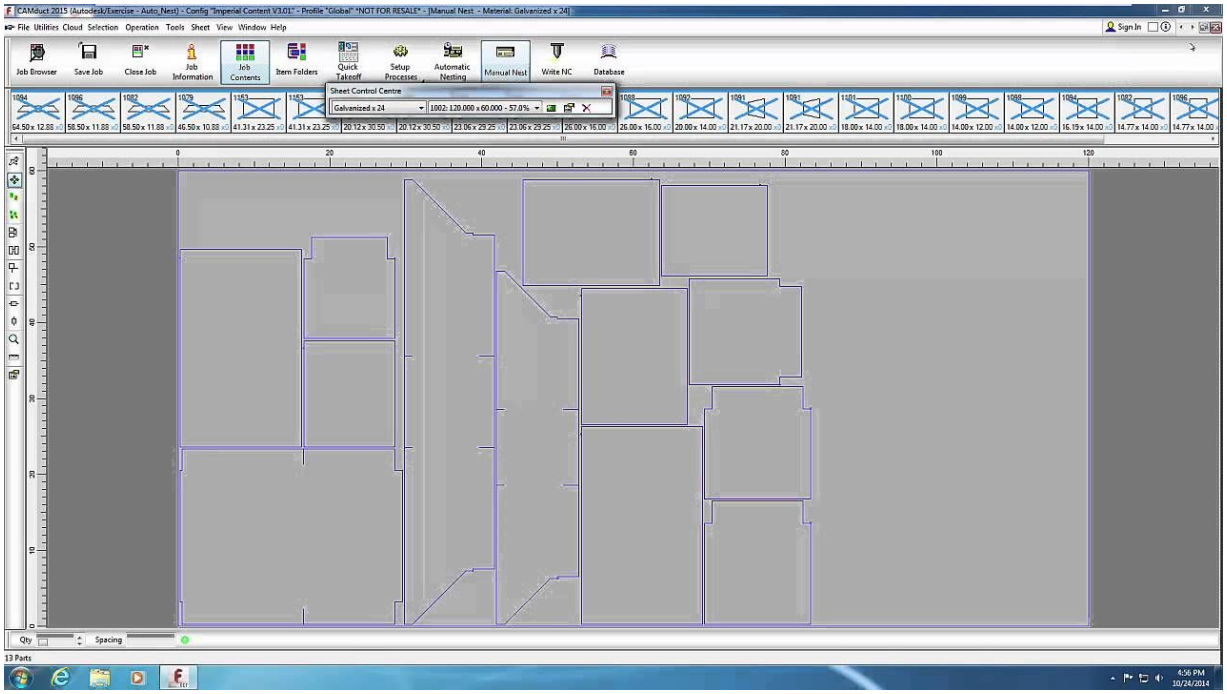


Modeling HVAC in CADmep (image by Autodesk).

Use case	Focus on Fabrication and Detailing of MEP Systems
Vendor	Autodesk
Cost	$1,890 (also see Autodesk MEP Fabrication Suite bundle)
Compatibility	Connection with ESTmep and Revit. Fabrication ITM content is fully compatible with Revit 2017 and the MAJ file format strengthens the workflow between the Fabrication suite of tools and Revit. Compatible with Navisworks.
Pros	ITM files are easy to edit and manage. The spec drives the part. As you change the size, the item manipulates the data associated with it. Has industry standard (HPH) pricing and labor rates built into the items. Simplified workflows to and from Revit. ITM files can be brought directly into Revit starting in

	version 2016 through the MAJ format. ITM content can be used in Revit to enhance MEP modeling capabilities.
Cons	Even though we saw first-hand full round trip coordination with Revit, CADmep and ESTmep this workflow is not currently supported by Autodesk. This is a powerful workflow that comes along with a learning curve. The workflow with Autodesk Point Layout from CADmep is cumbersome and leaves room for improvement. Content for closet carriers, backflow preventers, pressure reducing valves and other items are not currently available if you prefab PRV stations.
Learning curve	The sheer number of features and options increase the learning curve. CADmep's learning curve is on the higher side of the intermediate scale.
Conclusion	This solution is deep. Autodesk has done a lot to develop this product since acquiring MAP over 4 years ago. The enhanced workflows with ESTmep and Revit through the ITM content in CADmep is a game changer. This allows users to model in Revit with all the rich data if they choose to do so. The ability to cross train estimators and drafters is now possible. Autodesk is focusing their resources for fabrication content around CADmep and using Revit families for the end of line equipment.

CAMduct

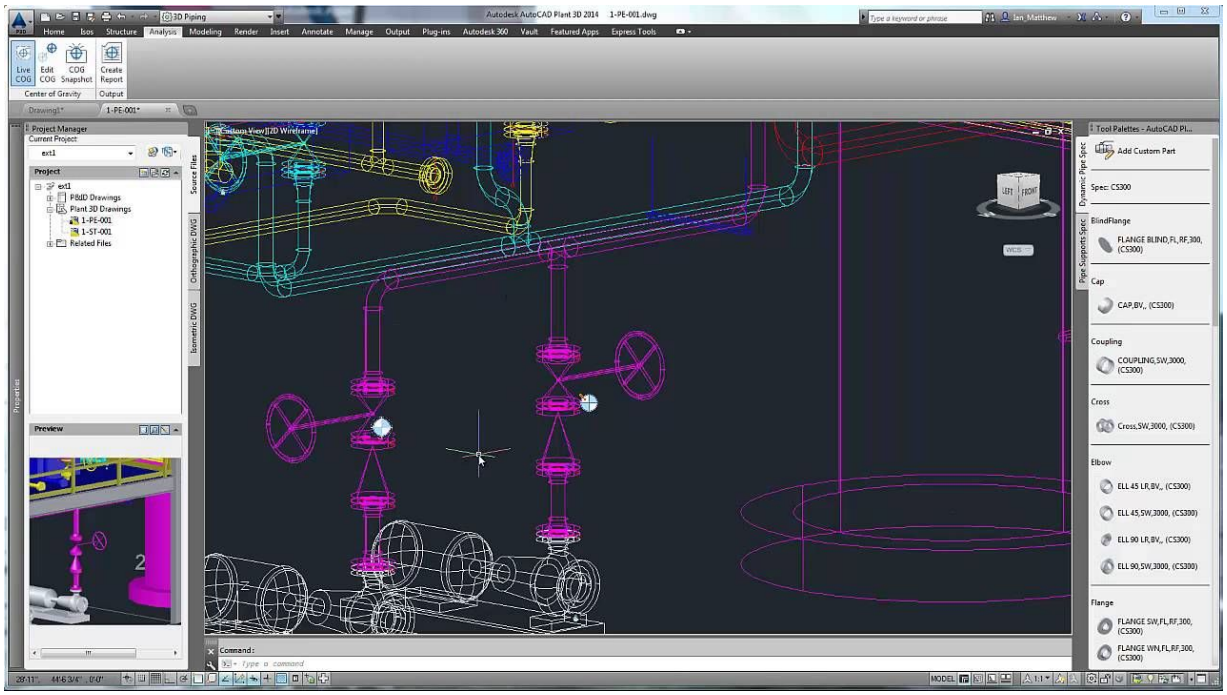


Nesting in CAMduct to create an optimal cut (image by Autodesk).

Use case	Allows users to produce fabrication level models of duct systems.
Vendor	Autodesk
Cost	$2,000 - $5,000
Compatibility	Fabrication Tracker and Fabrication RemoteEntry. Also integration with Revit and ESTmep through ITM and MAJ files.
Pros	In 2017 improved connection with Revit. Library ITM content can be used directly in Revit and imported into CAMduct to create nested plans that connect to plasma cutters. Massive list of parametric parts used for fixtures and fittings.
Cons	The learning curve is on the higher side due to integrations with ESTmep and Revit.
Learning curve	Higher end of Intermediate

Conclusion	The newly enhanced integration with Revit and ESTmep streamlines communication between design and construction. Revit models can be pulled into CAMduct along with all ITM content. CAMduct gives users the ability to leverage design models and develop them further through the fabrication process.

Plant 3D

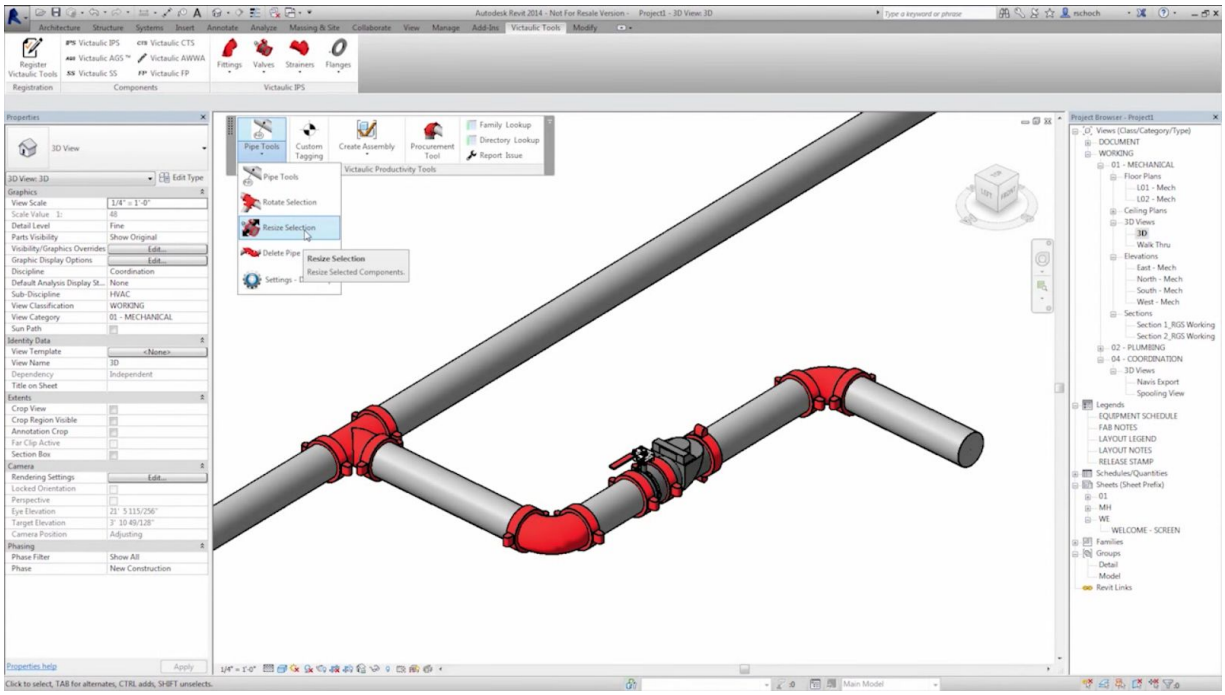


Modeling industrial piping in Plant 3D (image by Autodesk).

Use case	Focus on Heavy Industrial Projects.
Vendor	Autodesk
Cost	$3,780
Compatibility	Built on AutoCAD Engine. Supports open, standards-based data exchanges like ISO-15926. Strong integration with Autodesk Vault, and Autodesk P&ID.
Pros	Users can access a lot of manufacturer content for industrial equipment through the connection with Autodesk Inventor. Provides users with the ability to model structure along with creating custom parametric parts. Strong interface with P&ID gives users the ability validate data. Also has analysis features built into the software allowing users to perform additional calculations.

Cons	Content and workflows are focused on heavy industrial systems. Workflows with Revit are limited.
Learning curve	Intermediate level
Conclusion	Widely used among companies designing and constructing industrial systems. The tool provides users the ability to to design and construct steel, piping systems, parametric equipment, and more. Also, provides users with analysis tools the validate systems.

Victaulic Tools for Revit

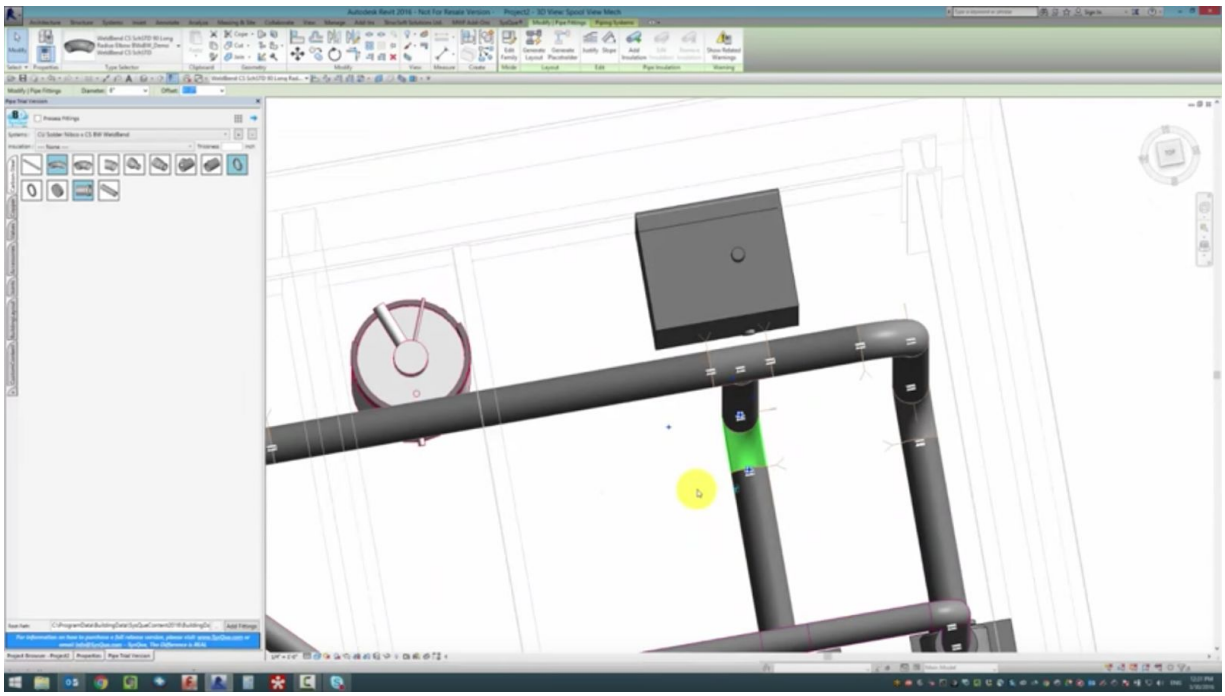


Modeling using Victaulic components with Victaulic Tools for Revit (image by Victaulic).

Use case	Pipe splitting, assembly creation, instant resizing, pipe deletion, pipe rotation, smart tagging and hanger placement.
Vendor	Victaulic
Cost	Victaulic Tools for Revit 2016: $150 Victaulic Tools for Revit 2017: $200
Compatibility	Add ons available for Revit 2014 through 2017. Compatible with other manufacturers than Victaulic. Also Fabrication Parts in 2016 and 2017.
Pros	Victaulic Tools add functionality to Revit improving pipe routing and the ability to generate spool drawings. These productivity tools can save users countless hours when authoring MEP systems on Revit.

Cons	Victaulic tools greatly enhance the power of Revit, but there are still limitations within Revit on the MEP side of the software.
Learning curve	Easy learning curve for those that already know Revit.
Conclusion	Victaulic has 70 professionals on staff that come from the MEP industry. They provide BIM outsourcing services and found limitations within Revit on the MEP side of the solution. Victaulic created these productivity tools for Revit to improve splitting, tagging, rotating, and resizing pipe. They have also simplified hanger placement and assembly creation. These tools provide Revit users with the ability to produce spool drawings and bill of materials directly within Revit.

SysQue for Revit

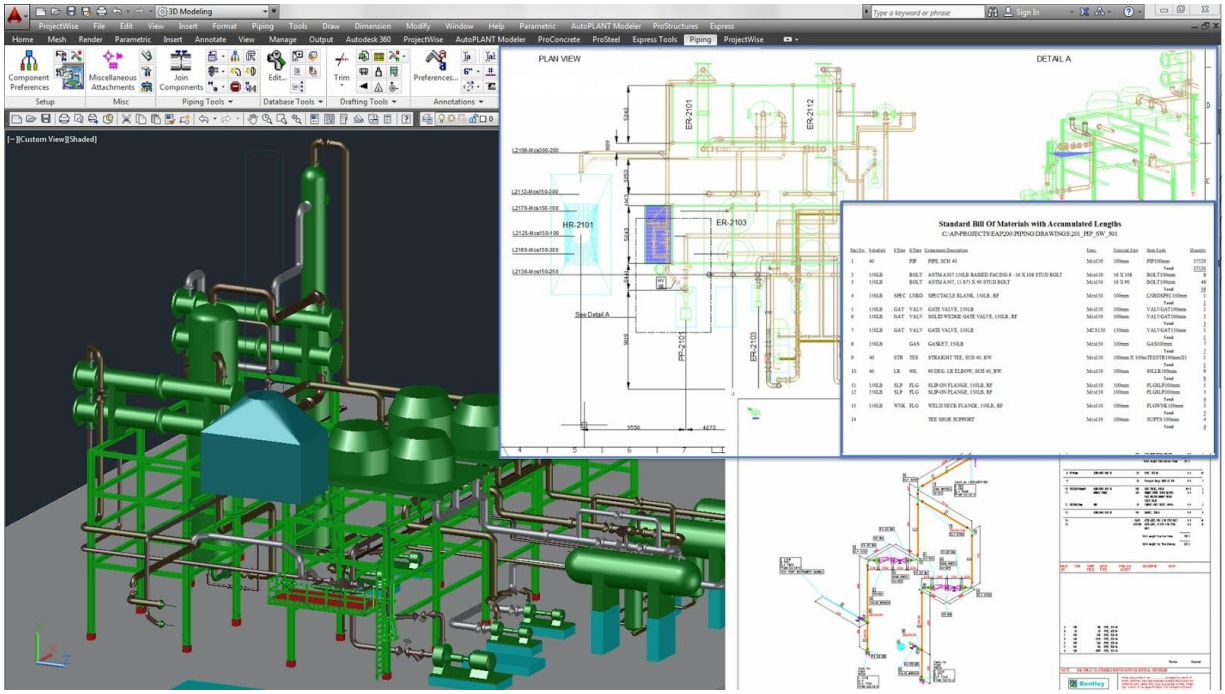


Drawing pipe in SysQue for Revit (image by SysQue).

Use case	SysQue allows users to take design models created in Revit and assign manufacturer specific content that supports fabrication level models.
Vendor	Sysque
Cost	Not available
Compatibility	Data and content compatible with Revit. Powerful connection with Trimble units for job layout.
Pros	SysQue products allows users to stay in Revit and produce detailed MEP models that can be used through fabrication. This simplifies workflows throughout the BIM/VDC process. The ability to coordinate and share models with other project teams using Revit is straightforward. Extensive list of families with assigned manufacturer specific content.

Cons	Modeling (hanger placement) and generating bill of materials in Revit with SysQue content is more time consuming than other systems we reviewed in this report. If a particular component required for a model is not in the SysQue database, SysQue's turnaround can be up to 6 weeks. We did experience issues with the spooling module that was recently redesigned in SQ. It crashed Revit multiple times and we were unable to create spool sheets. These issues are currently being addressed by SysQue.
Learning curve	Intermediate
Conclusion	SysQue provides users with real-world content inside of Revit that can be used to support fabrication and construction coordination. SysQue offers a number of products that provide users with specific solutions to address many different needs. PAC supports integrations with CAMduct, Vulcan, and Vicon to offer CNC support. Spool enables Revit to produce models to LOD 400 along with automating your bill of materials and spool sheets. SysQue offers solutions for all MEP professionals. SQ Pipe, SQ Duct and SQ Electrical all connect with SQ Data providing Revit users with tools that allows them to stay inside Revit and produce their MEP plans, models, BOM, and more.

Bentley AutoPLANT

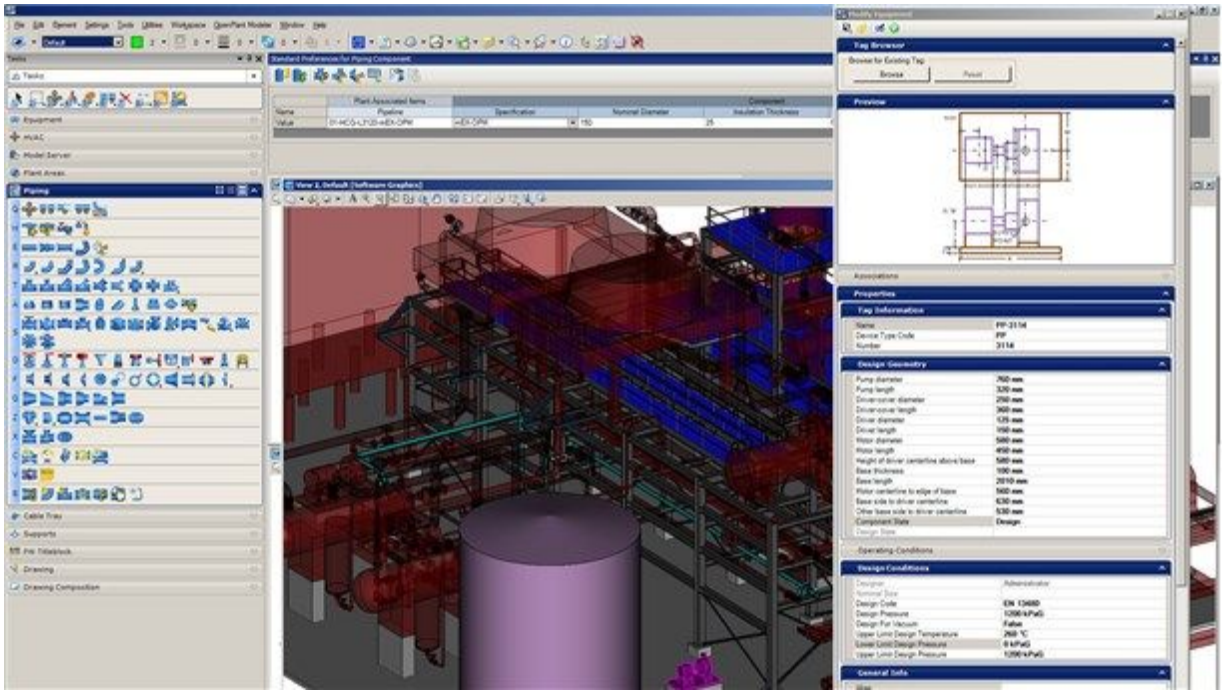


Using AutoPLANT to generate a spool and bill of materials from a model (image by Bentley).

Use case	Built on the AutoCAD Engine - Large Bore Industrial Focus
Vendor	Bentley
Cost	Not available
Compatibility	Compatible with Bentley tools. Navigator, ConstructSIM, ProSteel, StaadPro and Connect.
Pros	Easy to learn for those with AutoCAD experience. Streamlined workflows with Bentley products. Spec driven workflows links to dynamic database of parts including manufacturer content. Strong pipe modeling tool. Provides users ability to do piping analysis.
Cons	No connection with industry pricing and labor codes. Limited manufacturer content.
Learning curve	Intermediate

Conclusion	AutoPlant is focused on modeling piping and automatically generating your bill of materials, spool sheets and other views directly from the model. Supports IFC and DWG extremely well.

Bentley OpenPLANT



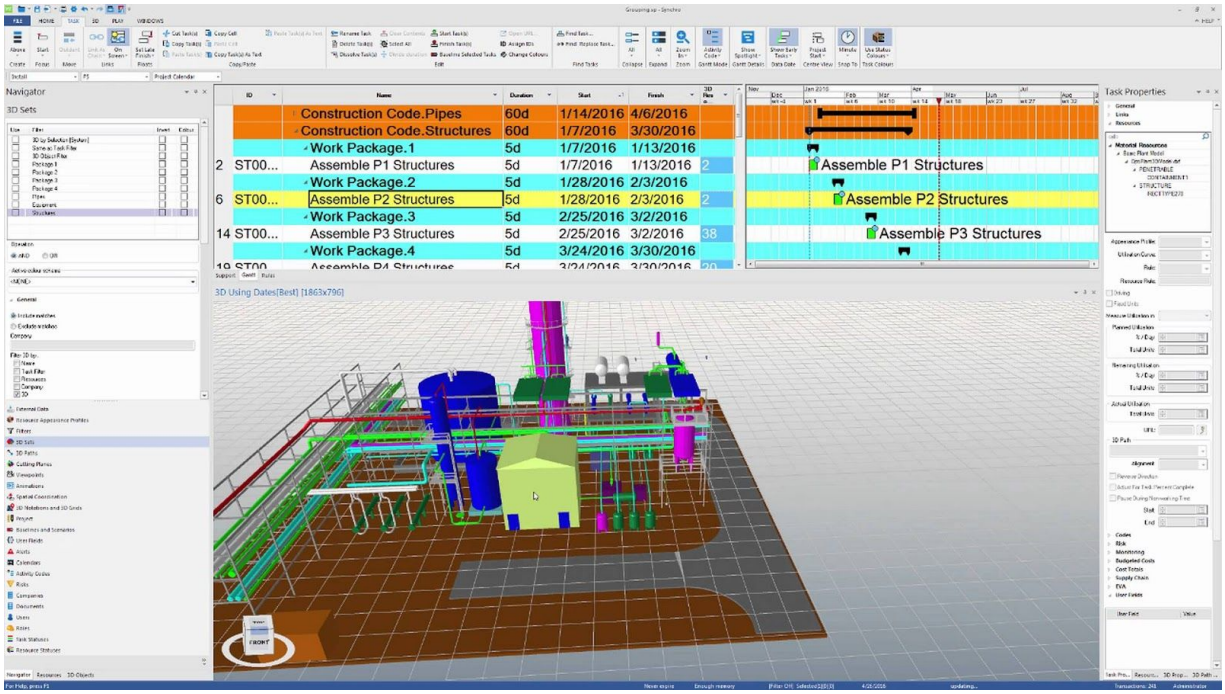
Modeling plant objects with attributes in Bentley OpenPLANT (image by Bentley).

Use case	Built on the Microstation Engine - Large Bore Industrial Focus
Vendor	Bentley
Cost	Not available
Compatibility	Compatible with Bentley tools. Navigator, ConstructSIM, ProSteel, StaadPro and Connect.
Pros	Easy to learn for those with MicroStation experience. Streamlined workflows with Bentley products. Spec driven workflows links to dynamic database of parts including manufacturer content. Strong pipe modeling tool. Provides users ability to do piping analysis.
Cons	No connection with industry pricing and labor codes.
Learning curve	Intermediate

Conclusion	AutoPlant is focused on modeling piping and automatically generating your bill of materials, spool sheets and other views directly from the model. Supports IFC and DWG extremely well.

Construction Management Software

Synchro PRO

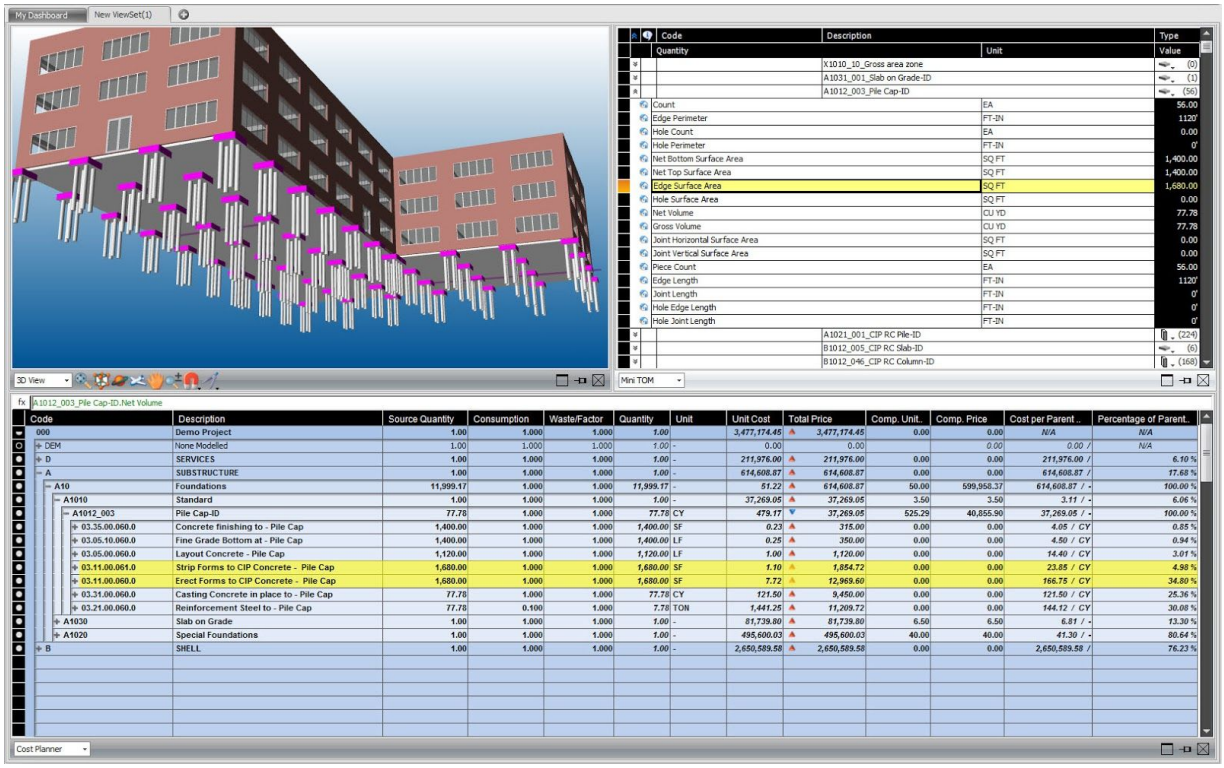


Scheduling components in Synchro Pro (image by Synchro).

Use case	Linking project schedule to BIM
Vendor	Synchro
Cost	$695: 30 days one user $895: 30 days multi user $1,095: 90 days one user $1,495: 90 days multi user $2,995: annual one user $4,495: annual multi user
Compatibility	Import schedules from Oracle Primavera, Microsoft Project, Microsoft Excel, Asta Powerproject. Import models using IFC, DWF and DWG formats. Plugins available for Navisworks, Revit, Microstation, and SketchUp.

Pros	Synchro Professional provides complete construction visualisation, project scheduling, risk management, cost allocation and design change management. One of the more advanced features of Synchro Professional is the ability to try out and compare multiple timelines and schedules to either arrive at the optimised result or create a solution to a problem that has been caused due to lack of availability.
Cons	The mark-up and reporting tools for clash detection have some limitations when compared to other industry tools.
Learning curve	Relatively easy to learn the basics. More advanced features require more time to grasp. Best in class online training resources.
Conclusion	This is a macro BIM tool focused on supporting 4D (Space & Time) BIM. If you want to link a schedule to your model and visually communicate your schedule to the project team or owner this is a great solution. Synchro is a powerful planning tool that allows users to virtually plan and coordinate projects. Additional products like Open Viewer and Scheduler provide users with free tools to assist with clash detection and scheduling. While their Site mobile app allows users to track progress in the field and update the schedule on your iPad.

Vico Office Suite

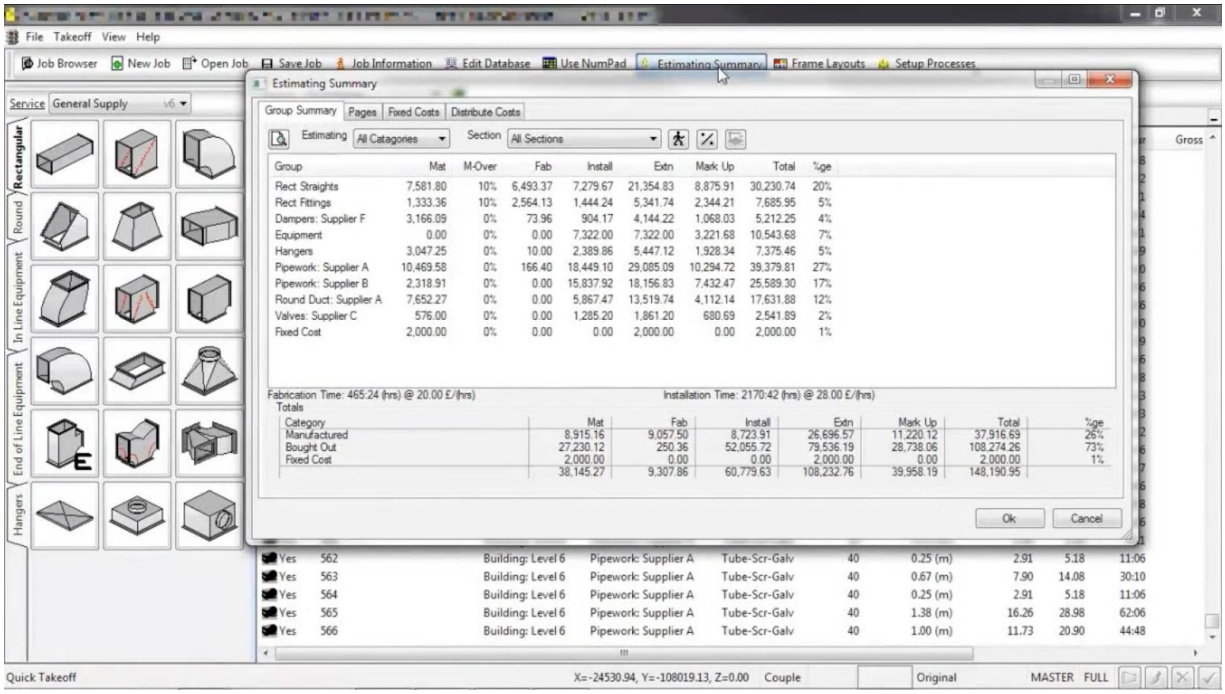


Quantity takeoff in Vico Office (image by Vico Software).

Use case	3D change management, BIM visualization and reporting, clash detection, layout, quantity takeoff, 4D scheduling, 5D estimating
Vendor	Trimble
Cost	Vico Office provides a modular-based workflow to help support implementations of many different workflows and sizes; entry into the product can be achieved for as little as a couple hundred dollars per year for a workflow subscription license, all the way up to full roll-out of perpetual licensing at the enterprise level.
Compatibility	Revit, Tekla, ArchiCAD, CAD-Duct, IFC, SketchUp, 3D DWG
Pros	Allows you to bring in models from Revit, SketchUp, ArchiCAD, Tekla along with DWG and IFC file types into Vico. You also have

	the ability to import Excel and Timberline data and connect it to your models. Vico provide users a platform to take deep dives into BIM connecting cost, time, labor and more to your models.
Cons	Expensive with steep learning curve.
Learning curve	Steep - Recommend using their team of project consultants on the first couple projects to build cost database into the system.
Conclusion	Vico Client is a modular platform that provides users with the ability to dive deep into the BIM process. This tool is not for your average BIM user. It requires an in-depth knowledge of multiple facets of construction along with learning a sophisticated piece of software on top. We recommend that you engage Vico's team of consultants on the first project if not two. They can help you setup your pricing database in addition to other components. If you are looking to get the most out of your models Vico is worth exploring.

ESTmep

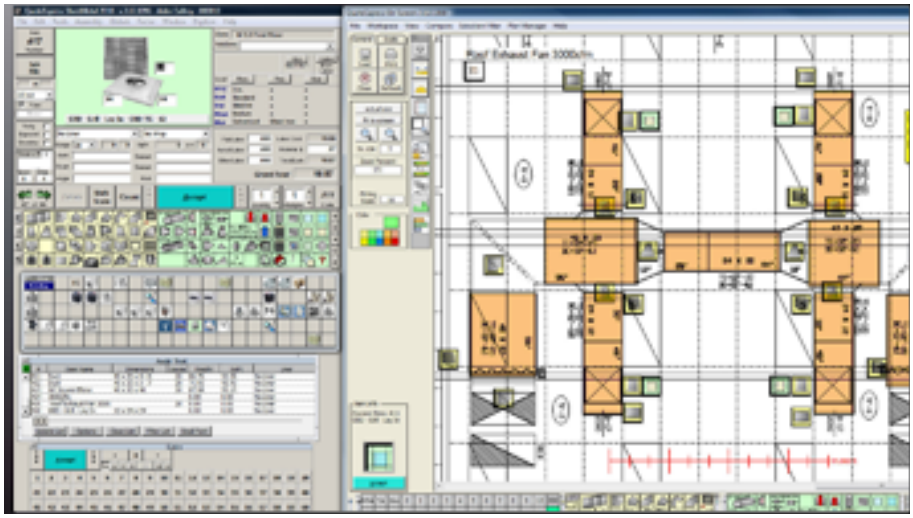


Viewing estimate information in ESTmep (image by Autodesk).

Use case	Quick and Accurate Estimates of Building Systems
Vendor	Autodesk
Cost	$1,890 (also see Autodesk MEP Fabrication Suite bundle)
Compatibility	CADmep, CAMduct, and Revit
Pros	In 2017 streamlined workflows to import models from Revit and AutoCAD MEP to produce take-offs. Allows users to quickly turn design intent models into fabrication levels models that includes labor and cost data. Users can quickly make changes to building systems and visualize the cost by color. Allows companies streamline workflow from pre construction phase into construction.
Cons	ESTmep workflows requires more time than traditional on-screen estimating solutions.

Learning curve	Intermediate Level
Conclusion	With the release of the new features in 2017, ESTmep has a much stronger integration with Revit and AutoCAD MEP allowing users to gain a strong understanding of the project cost. ESTmep workflows improves internal communication, while leveraging information coming out of the estimating phase.

QuoteSoft



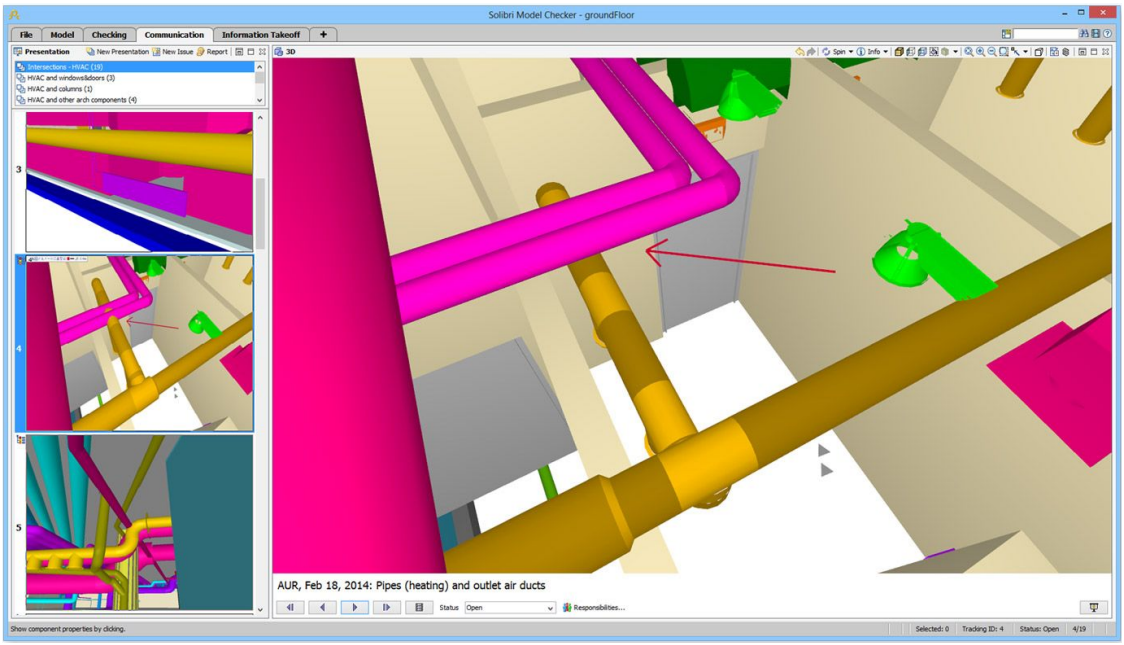
Estimating ductwork in QuoteSoft (image by QuoteSoft).

Use case	Mechanical estimating software
Vendor	QuoteSoft
Cost	Not available
Compatibility	EC-CAD, CADPIPE, Drawtec, CADmep, CAMduct, Vulcan, Shop Data, and Revit
Pros	Imports and Exports to standard AutoCAD XML BIM data format. Ability to apply labor adjustment factors for floor / height / etc. Outputs labor hour and material cost data back to BIM Files. Outputs labor and material data to Excel with powerful sorting capabilities.
Cons	More focused on a 2D (PDF, JPG) workflow and doesn't fully leverage the 3D geometry like other tools.
Learning curve	Easy
Conclusion	QuoteSoft allows users to leverage their estimating data throughout the BIM process with labor hours and material costs that can be used for additional BIM functions including scheduling, sequencing, prefabrication, cost analysis, and

	installation. QuoteSoft can import from all Autodesk and third party CAD software like EastCoast, CAMDuct, CADmep, SDS, and Drawtech through the CAD-Connect tool.

Model Review Software

Solibri Model Checker

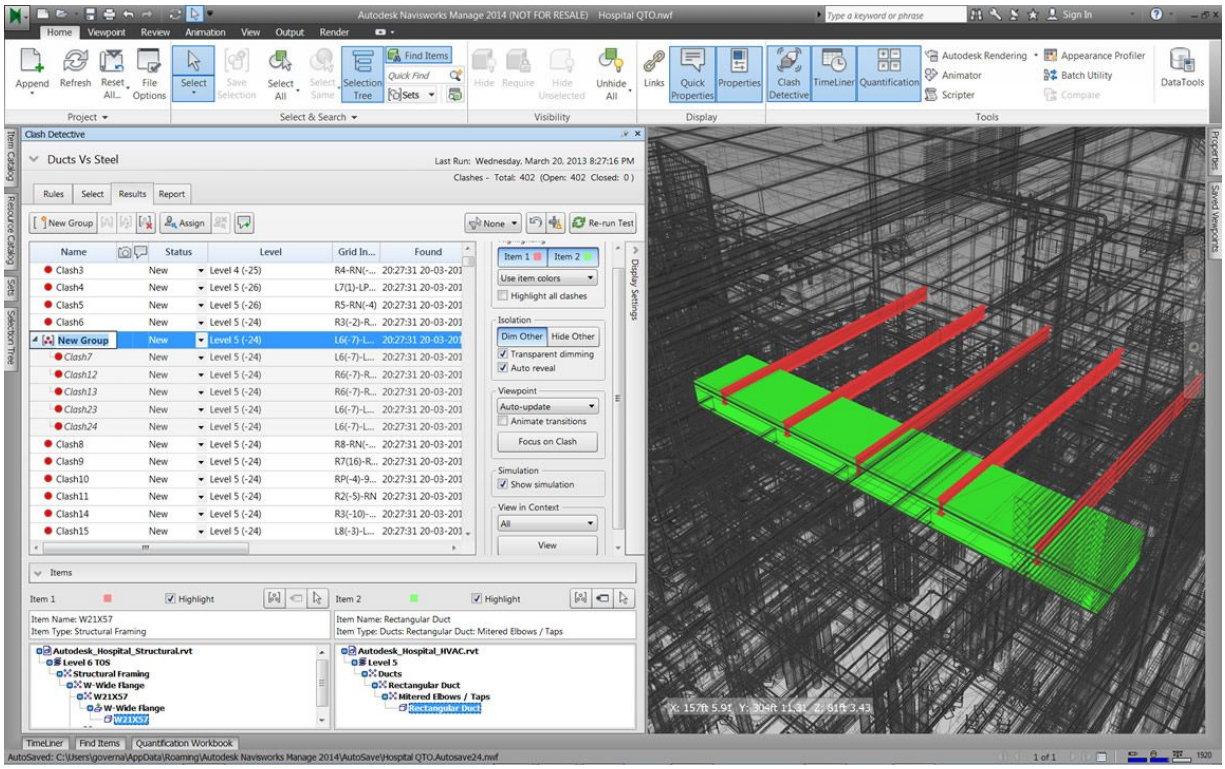


Visualization of a change order in Solibri Model Checker (image by Solibri).

Use case	BIM clash detection, missing element detection, element matching, model checking, change order management, design versioning, and custom rule based checking.
Vendor	Solibri
Cost	$6k - $7k
Compatibility	Can import IFC and DWG file types. BCF import via plugin.
Pros	Rulesets are what set Solibri Model Checker apart from any other model aggregators on the market. Once the Classifications are set up correctly, you can use the rulesets for Clash Detection, Quality Assurance, Model Checks, Missing Parameters, Naming Conventions, Building Logistics, Code Compliance, and even Validation of Design Ideas. Setting up custom classifications, is easier than setting up search sets in

	Navisworks. Rulesets can be used to automate code compliance.
Cons	When comparing Solibri to Navisworks you will not find any features comparable to the TimeLiner for 4D simulations.
Learning curve	Straight-forward learning curve for most features. Learning to create custom rulesets takes some time to grasp initially.
Conclusion	Solibri is a powerful tool that allows user to gain trust in models they receive from other professionals involved in the BIM process. As we progress down the BIM path the ability to determine the quality of models will play a significant role in the next level of adoption. Solibri rules based checks has the ability to quickly check for code compliance, model development, and much more. Large owners like the General Services Administration have already built their rules into Solibri. Users can access those rules when you purchase the software.

Navisworks Manage

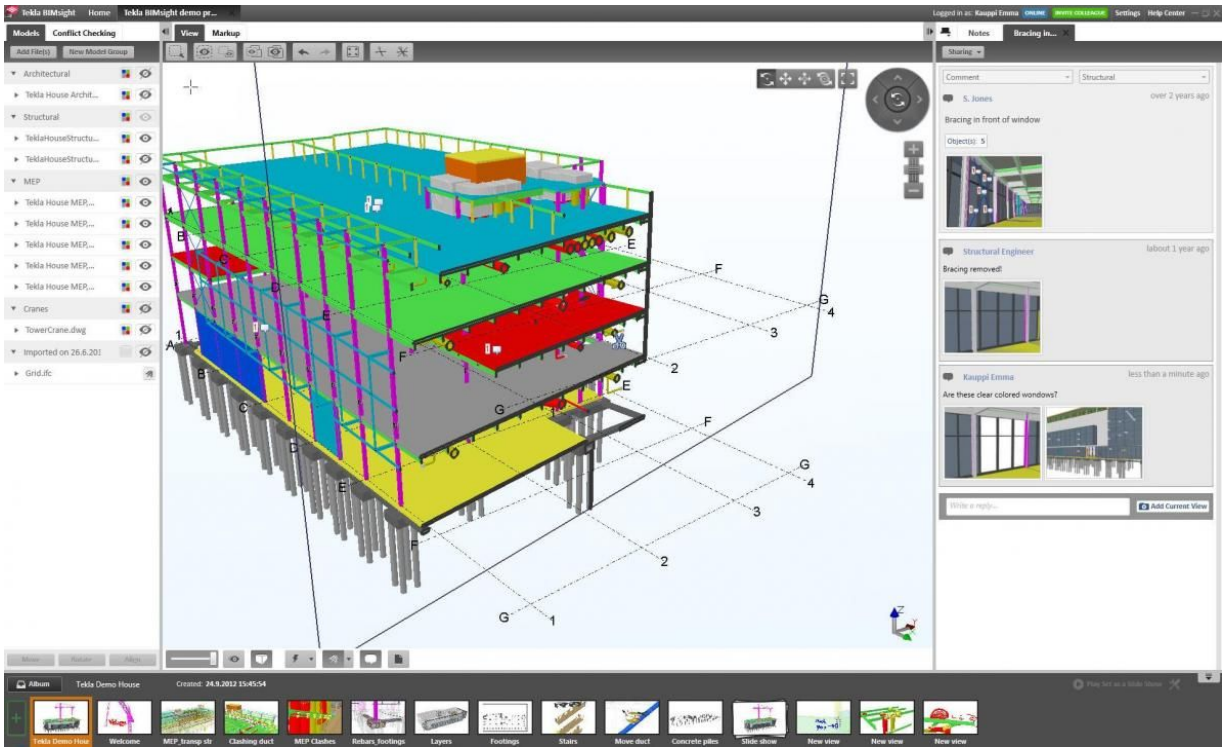


Identifying and managing a detected clash in Navisworsk Manage (image by Autodesk).

Use case	Allows everyone on the project team to review the federated model and data and coordinate to improve project outcomes.
Vendor	Autodesk
Cost	$3,280
Compatibility	AutoCAD, Revit, BIM 360 integration, Supports numerous 3rd party applications SketchUp, SolidWorks, FBX, IFC, PDF, DGN, STL, CIS/2 and more.
Pros	Shared workflows with BIM 360 products. Best in class model markup tools. Easy to use and handles large models extremely well. Supports a lot of different file formats.

Cons	Have to export then manage multiple models for clash detection. Batch export tools help simplify this process but still require information managers to manage multiple files.
Learning curve	Easy
Conclusion	Navisworks is widely used across the AEC industry by design and construction professionals. The software is easy to learn and provides all levels of BIM users with a tool that allows them to federate models created in numerous authoring tools into a single solution. This federation of models allows everyone to review and coordinate their portion of the project to reduce issues in the field. Navisworks Freedom is a free viewer that puts Navisworks files (NWF) in everyone's hands. Navisworks Simulate provides users with an added level of control for both (4D) time and (5D) cost. Navisworks is a powerful and simple tool that enables communication and model sharing for all project participants.

Tekla BIMsight



Inspecting nodes on a model in Tekla BIMsight (image by Trimble).

Use case	Combine models, check for conflicts, and communicate issues
Vendor	Trimble
Cost	Free
Compatibility	IFC, SKP, and STEP files supported
Pros	Powerful free software that handles models from numerous BIM solutions. Easy to use and Tekla BIMsight Note is supported on iOS and Android mobile devices.
Cons	Markup features are not as robust as other model review solutions. Larger models tend to run slower than other solutions.
Learning curve	Easy

Conclusion	Tekla BIMsight is a free professional tool for construction project collaboration. The entire construction workflow can combine their models, check for clashes, and share information using the same easy-to-use BIM environment. Tekla BIMsight enables project participants to identify and solve issues

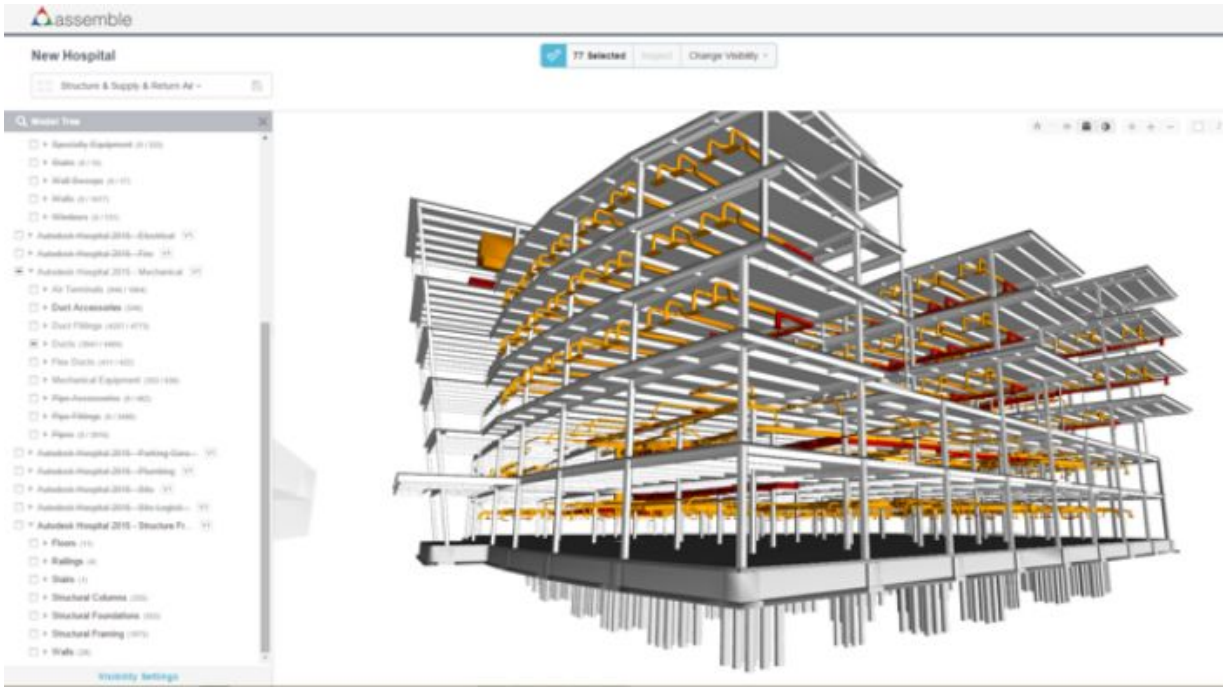
Bentley Navigator

Inspecting nodes on a model in Bentley Navigator (image by Bentley).

Use case	Review, navigate, and mark-up 3D models along with associated drawings and documentation of all sorts.
Vendor	Bentley
Cost	Not Available
Compatibility	IFC, DWG, DGN, and Integrated connection with ProjectWise
Pros	Access project information on the device of your choice with support for PCs, tablets, and other hybrid devices running Windows, iOS, and Android operating systems. Use the same applications whether in the field, in the office, or on-site, and synchronize whenever you have time, with the ability to work on

	models and associated documents without network connectivity.
Cons	Some data populated to models in Autodesk and Trimble solutions is lost in translation.
Learning curve	Intermediate
Conclusion	Bentley Navigator connection to Navigator Mobile enables users to go offline with their models on Windows, iOS, and Android devices and easily sync back to current model when a connection is available. This workflow greatly improves coordination in the field and makes it easy for more team members to review models and provide valuable feedback.

Assemble Systems



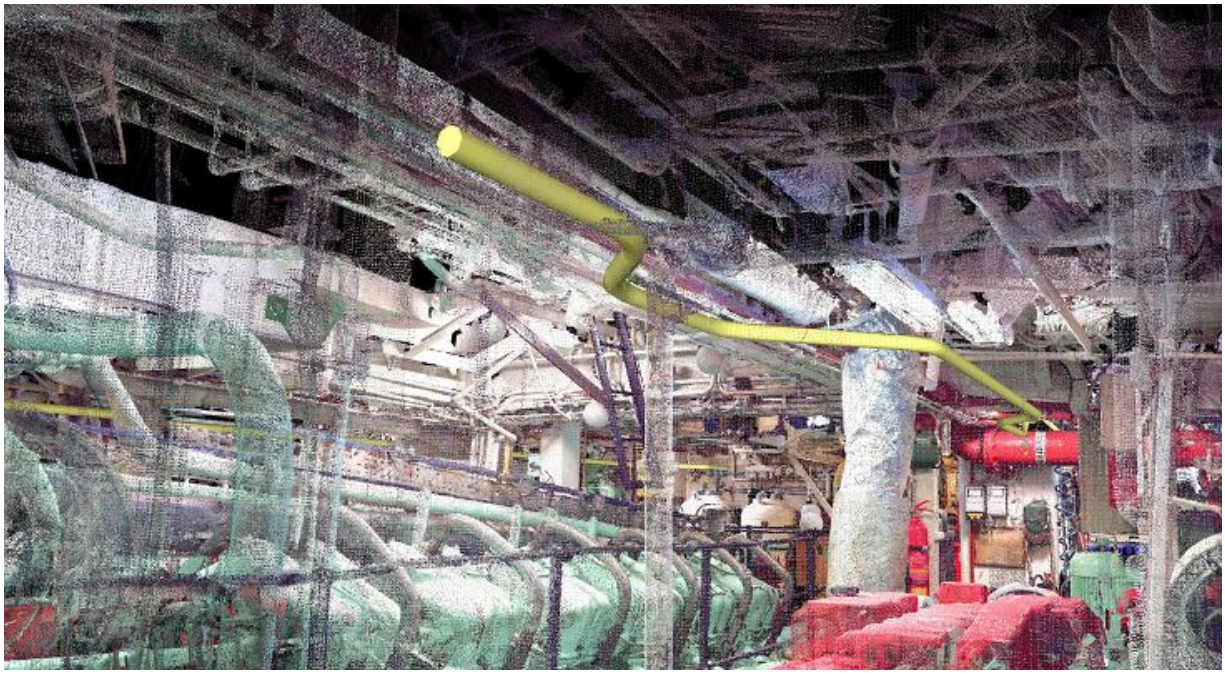
A hospital BIM model in Assemble (image by Builtworlds).

Use case	Automated model-based quantity takeoffs.
Vendor	Assemble Systems
Cost	Not available
Compatibility	Revit and AutoCAD Add-Ins Exporter
Pros	Extracts model information and send it to the cloud so your team can access and use BIM data in a web browser. Use variance to track changes for any numerical model property such as Cost, Area, Length or Weight. Integrates with Navisworks to bring a visual dimension to the tabular data in the model inventory. Inventories extracted are linked to the model viewer, providing a visual validation of the data. Accurately quantify and visualize takeoffs, changes and cost implications, quickly and with ease.

Cons	Only supports Revit and AutoCAD file formats.
Learning curve	Easy
Conclusion	Using Assemble, project teams can access, analyze, condition, and share model-based building information to improve preconstruction and construction processes including design reviews, takeoffs, estimating, change management, value engineering and schedule management through any web browser.

What's next?

Building Systems Planning, Inc. - GenMEP



A pipe auto routed through a point cloud (image by BuildingSP).

Use case	Algorithmically route MEP systems without clashes.
Vendor	Building Systems Planning, Inc.
Compatibility	Revit Add-In and Supports IFC files.
Pros	Supports Routing within point clouds, linked files, or imported IFC files. Auto-routes at 90 degree angles only, any angles, or combinations of 45-degree and 90-degree angles for conduit.
Cons	Still in beta
Learning curve	Straightforward to create start and end points and auto calculate the pipe run. Software is still in beta.

Conclusion	Computational BIM is the use of computers to leverage, extend, and improve otherwise manual tasks in BIM. Computational BIM uses the power of algorithms and automation to lower the amount of manual input, increase modeling cadence, and improve quality.

What didn’t make it?

These solutions didn’t make the list of evaluations:

Trimble MEPdesigner for Sketchup

While MEPdesigner for Sketchup is intended to become a comprehensive MEP solution for the Sketchup platform, it currently only has support for electrical conduit design.

References

This report was created with the aid of:

- Assemble Systems
- Autodesk, Inc
- Bentley Systems Inc
- Carrier Corporation
- EastCoast Products
- Mechanical Contractors Association of America
- Orange Technologies Inc
- Solibri, Inc
- Synchro Software Ltd
- SysQue
- Trimble
- VICO Software
- Victaulic Company
- Quote Software Inc