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# AUGIWorld

The Official Publication of Autodesk User Group International

August 2012

## True Teamwork *How Autodesk Products Foster Collaboration*

Also in this issue:

- The Truth about Sharing Inventor Data
- Best Practices for Revit Collaboration
- The Importance of Workflow



HP recommends Windows® 7.

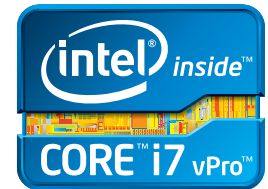


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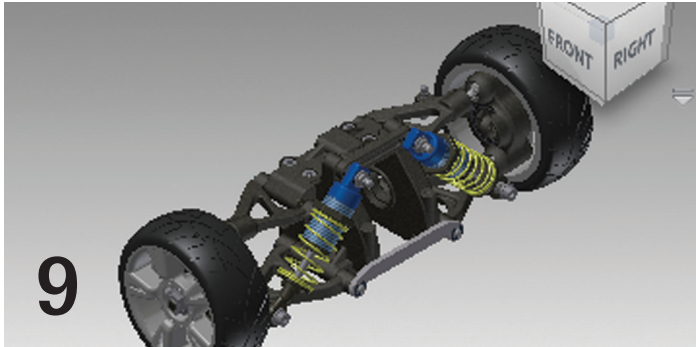
<sup>1</sup> Requires an 2nd gen Intel® Core™ processor, enabled chipset, Intel Rapid Storage technology software, and a properly configured hybrid drive (HDD + small SSD). Intel Smart Response Technology is sold as an optional feature and is only available on HP's 2012 Workstations, HP EliteBooks and HP UltraBook. Depending on system configuration, your results may vary.

<sup>2</sup> Testing was not intended to demonstrate fitness for DOD contracts requirements or for military use. Test results are not a guarantee of future performance under these test conditions.

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Cover image:  
 Project: Gaillard Center; Charleston, S.C.  
 Architect of Record: Earl Swensson Assoc., Inc.  
 Design Architect: David M. Schwarz Architects, Inc.  
 Structural Engineer: Walter P. Moore  
 MEP Engineer: I. C. Thomasson Associates, Inc.

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## UPDATE?

**Spring Release: New Autodesk Software**

Autodesk has made the transition to new software easier, but there are still some protocols you should follow when making the transition. Here are some tips on making the transition as smooth as possible.



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## What's New in Autodesk 2013 Products?



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## AUGIWorld Magazine

is a monthly magazine designed to help readers improve their use of Autodesk products and learn new techniques. Every issue is packed with product tips & tricks and other technical fare, management issues, and education trends. Distribution is worldwide.





# AUGI



Dear *AUGIWorld* reader,

Welcome to the August 2012 issue of *AUGIWorld*! This month we are focusing on collaboration, and how it is related to Autodesk software products. Very few of us are single product users. We typically use AutoCAD or some variant and then something else, be it Revit, Adobe, or even another CAD product.

The first collaboration problem we often encounter at the beginning of our careers involves data file type. For example, in my work I get DWG, RTV SKP, NWC, MAX and other file types. One of my first tasks is seeing how the native programs can collaborate—can I use a native data type in another application? An example of this is linking a DWG into a Revit model. From that, the complexity only gets tougher.

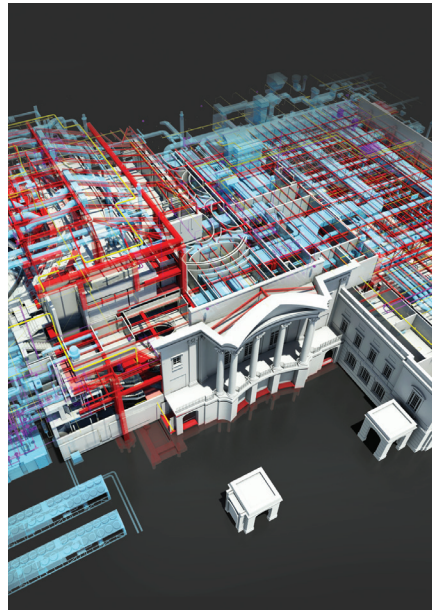
In this edition of *AUGIWorld* many of our authors take up the cause of collaboration and explain their unique collaboration problems and their personal experiences in solving these problems. I encourage you to explore the insight our authors have shared with you. These are not simple issues to solve, and everyone can benefit from more consolidated knowledge!

For our cover this issue we present an image that recently received accolades. It won Best Integration in the graphics competition held at the Revit Technology Conference North America 2012. This month's cover image is supplied by Eric Klotz of Earl Swensson Assoc., Inc., Nashville, TN USA. This project was a team effort – see the Table of Contents for the complete list of partners who created this wonderful work!

If you have imagery you would like to submit for an *AUGIWorld* cover, just contact us. We love to highlight our members' work!

Until next time, happy reading!

*David Harrington*



## AUGIWorld

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### Editors

#### Editor-in-Chief

David Harrington - [david.harrington@augi.com](mailto:david.harrington@augi.com)

#### Copy Editor

Marilyn Law - [marilyn.law@augi.com](mailto:marilyn.law@augi.com)

#### Layout Editor

Tim Varnau - [tim.varnau@augi.com](mailto:tim.varnau@augi.com)

### Content Managers

3ds Max - Osama Ali

AutoCAD - Curt Moreno

AutoCAD Architecture - Melinda Heavrin

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Column: Built - James Salmon

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Product Review - Lonnie Cumpston

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# New and Varied Ways to Collaborate

 Collaborating with others on a CAD-related project means different things to different people. There are many aspects, many needs, and many methods that could be used to collaborate. Add to that the knowledge and experience of others (or lack thereof) and you can have real nightmare on your hands.

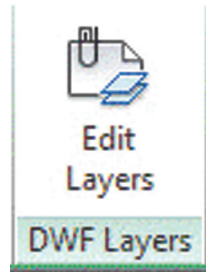
In recent years collaboration meant emailing your work to clients, vendors, and designers. They added to it and emailed it back. Or perhaps they used your work as a reference in their work and emailed that back to you. Either way, each party involved had to manage his own files and those of the other parties. Twice the work, but only half the fun. What if there was a way in which you could share your file with other users without actually giving them your file? Interested? Good.

## COLLABORATION IN AUTOCAD 2013 THOUGH DWF

AutoCAD® 2013 has several built-in collaboration tools. Some have been around for quite some time while others have been newly integrated into the program. One way to share your files is by providing a DWF or DWFx file. This gives others access to your line work in a secure format. They can't change the linework, but they can easily reference it, snap to it, print it, and even manage the drawings layers. This isn't new. The ability to create and reference DWF files has been around for a while now, yet the concept is foreign to many users. You may find that outside parties request PDF files to reference. Why use PDF when Design Web Format (DWF) is made by Autodesk for the purpose of CAD data exchange? It works very well with and in AutoCAD.

Once a DWF file is created, it can be emailed, printed, xrefed, redlined, or archived. How do you collaborate with a DWF file? A DWF file contains your CAD file's linework in an uneditable format, yet the recipient can access the linework and use it. Users can reference a DWF in their AutoCAD files. The linework can be snapped to, traced, and the layers can even be turned off. As long as the drawing's creator used good layer management (or at least good enough), then turning off unwanted linework won't be an issue. This also keeps your DWG files safe because they are never sent out.

Autodesk's Design Review is a free program that can open DWF and DWFx files. It can open a DWG file, but it will create a DWF copy of it. This process isn't always ideal as Design Review has to interpret how the drawing should look. The best way to create a DWF is to do it inside of AutoCAD. Trueview can print to DWF just as AutoCAD can. You will get better DWF results in DWF creation if you use AutoCAD or Trueview to print to DWF. Open your DWG file in either AutoCAD or Trueview and print. Use the DWF6ePlot.pc3 file for your Printer/Plotter device. Your DWG file will be "plotted" to DWF format. If you want the ability to turn off or on layers in a referenced DWF file, make sure to open the PC3 file and turn on the Include Layer Information setting. Click the Properties button in the plot manager next to the device name. Browse to the Custom Properties option. Click it. Then check the Include layer information box.



*Figure 1: You can manage a referenced DWF file's layers. Select the DWF and a Contextual ribbon tab will appear.*



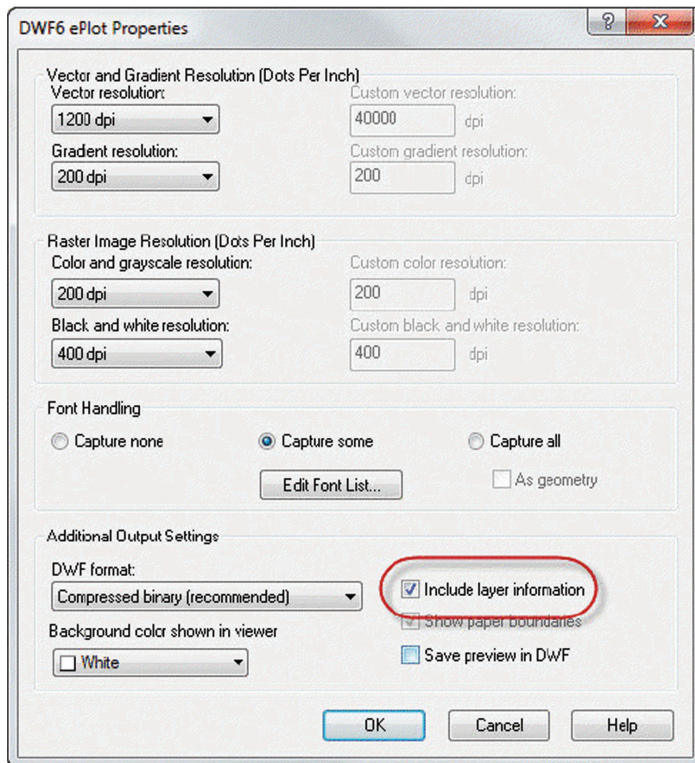


Figure 2: Make sure to turn on the “Include layer information” feature before printing to a DWF to make sure you can utilize this feature.

Once you have created a DWF file, you can send it to the appropriate people for review. Traditionally, drawings have been printed out and redlined, hopefully with a red pen or marker. (Can you call a drawing that has been marked up with blue pen a redline?) Once the drawings have been reviewed and marked, they are mailed back to you, or your collaborator can scan the drawing and email it to you. This method works.

With DWF files and AutoCAD, however, you can take your collaboration a step further. Create the DWF, email it or upload it via Dropbox, FTP, Buzzsaw, or Autodesk 360 (we will talk more about Autodesk 360 later.) The goal is to get the electronic file to recipients in a way that is fast and easy. Once they have it, they can open the DWF inside Design Review. There, they can help to deplete the rain forests by printing out the files or they can simply review the files onscreen using Design Review.

Design Review allows users to redline the drawings electronically. What are the benefits? Have you ever had trouble reading a redliner’s handwriting? Trust me when I say that reading typed text is easier than reading sloppy, “doctor like” handwriting. If a long note is in the redline, there is no need to retype it. Open the marked-up DWF, copy the text, and then paste it into AutoCAD.

AutoCAD also has a Markup Manager with which users can import the marked-up DWF file directly into their DWG file. Open the Markup Manager in AutoCAD and browse to the DWF file. This will open not only the redline DWF, but also the appropriate DWG file. Two steps in one. This allows easy collaboration between reviewer and drafter. It reduces confusion while commu-

nicating with drawings and creates an archive of what was done in the design process.

Autodesk also has a mobile version of Design Review for iOS and Android. It has most of the features that are found in the desktop version of Design Review. It can open DWF and DWFx files and mark them up. This makes for great collaboration at meetings or in the field. Users can take their drawings with them. It is very easy to pass around a tablet at a conference table and even easier to pass along a tablet while on the job site. While there, everyone can see and markup the drawings. When finished, send the marked-up DWF to everyone there. When they get back to the office it is ready and waiting.

## AUTODESK 360—COLLABORATION THROUGH THE CLOUD

Autodesk 360 is Autodesk’s free, cloud-based service. The crux of it is an online storage facility, but it is much more than that. It is a drawing viewer and can be used for collaboration and sharing. Anyone can set up a free Autodesk 360 account. In your favorite browser, go to <http://360.autodesk.com>. Set up a user name and a password or use your Autodesk login. If you have used AutoCAD WS, you can use that account.

Autodesk 360’s main purpose is online storage of files. Every account gets 3GB of free storage space. If you have an Autodesk Subscription license you are eligible for more space. You can upload files through the browser interface, through the AutoCAD WS website (<http://autocadws.com>), through the Autodesk 360-enabled mobile apps, or directly from AutoCAD.

AutoCAD 2013 has built-in AutoCAD 360 integration, which means that the capability is built into the natural functionality of AutoCAD 2013. No need for an add-on or update. It comes with AutoCAD out of the box (or out of the download, these days). After you start AutoCAD you can sign in to your Autodesk 360 account. You can even set it up so that AutoCAD automatically logs you into your account when you start AutoCAD.

AutoCAD 2010 and AutoCAD 2011 both have add-ons that you can download via the download page on the AutoCAD WS website. Gaining this functionality through add-ons won’t give you full Autodesk 360 integration, however. These add-ons were designed to allow AutoCAD to work with AutoCAD WS. They are similar to the integration in AutoCAD 2013 because AutoCAD WS uses the same storage services that are provided by Autodesk 360.

Why store your CAD files in the cloud? One reason is that it allows for easy access anywhere, regardless of your location (as long as you have an Internet connection, of course). Autodesk 360 offers more than just a place to put your files. It also has a history function. It keeps track of who uploaded the file and when, and who edited the file and when. Because it keeps track of these details, you can download and access a drawing’s history. If your client asks when the drawing was changed, you can go to Autodesk 360 and find out. This is where the collaboration tools in Autodesk 360 come into play. Autodesk 360 allows you to share your uploaded

# AutoCAD 2013

files. Log in, access the file details, and grant access to other users. There are two ways to share a file via Autodesk 360. One way is to specify who can access the file. The other is to make the file public.

Sharing with a specific user is simple enough, and yet there are several different access levels that allow you to fully control how the file can be used. There are four access level settings.

- View
- View and Download
- View, Download, and Update
- Full Access

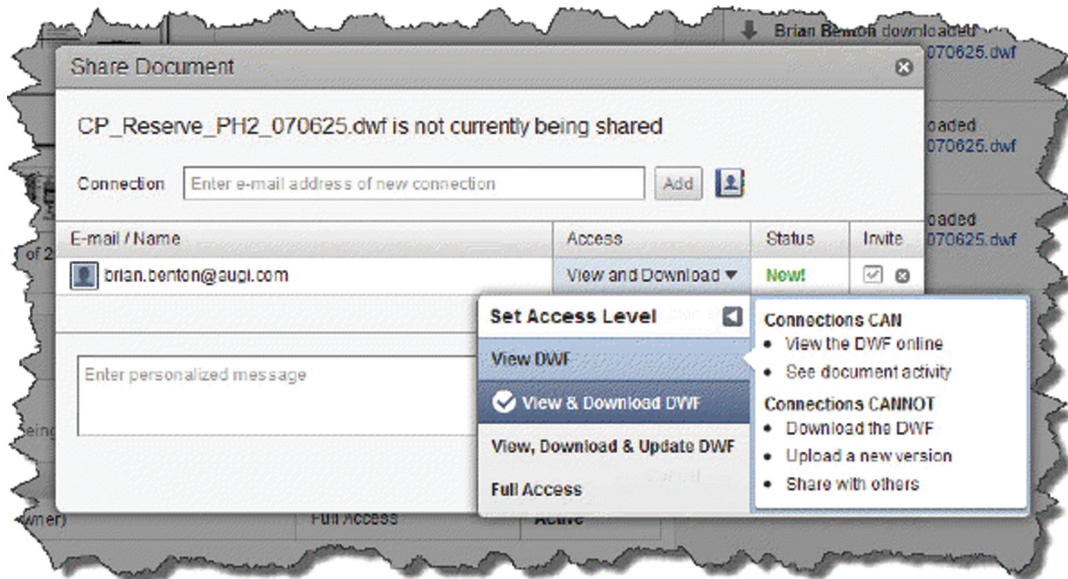


Figure 3: Autodesk 360 has many settings available that determine how your file is accessed by others.

The View setting allows users to view the file online and see document history. Autodesk 360 has an online viewer where users can look at the files. At the view access level, users can only see files. At the View and Download access level, users can view the files online, download the files, and see document activity. The View, Download, and Update level allows for online viewing, file downloads, viewing document activity, and online editing. This means that users can edit the files online via Autodesk 360 without any other special software. Full Access grants all of these rights plus the ability for users to share the file themselves. Use this setting only if you don't care who has your file. I would like to see a setting that enables online view and edit. There may be many times where I would want others to see the file and edit online, but I don't want them to actually have a copy of the file.

When you make a file public, it can be accessed by anyone. There is also the option to embed the file into your website. Careful though—when a file is publicly shared, it grants full rights to the file.

## MOBILE APPS

I've mentioned some mobile apps from Autodesk. Autodesk 360 works with many of them. AutoCAD WS accesses files from Autodesk 360, as well as via emails and other file storage services. The mobile version of Design Review (as of this writing) can only

access files that are in Autodesk 360. ForceEffect and ForceEffect Motion both access saved files in your Autodesk 360 account. You can upload files and access them in the cloud from mobile devices such as smartphones and tablets, wherever you are.

## COLLABORATING

There are many tools built into AutoCAD that can make collaborating with others easier than with more traditional methods. Take advantage of using DWF files and the free tools available that allow you to share, review, markup, and communicate your design needs. Autodesk 360 is another great free tool that can help you share, track, and manage your files. If you are on Autodesk Subscription, Autodesk 360 gives you more storage space. Let's face it, 3GB can get filled up very quickly. Subscription also gives you access to other cloud-based tools such as rendering services (some rendering services are available through the free service as well), design optimization tools, energy analysis, structural analysis, and BIM tools.

Over the last year or so, Autodesk has added many online, cloud-based, and mobile tools to its arsenal of design software and services. DWF files

were one of the first attempts to share files via the Internet. Since then Autodesk has kept the online ball rolling and moved into the mobile market. Autodesk 360 is the culmination of those endeavors. Look for Autodesk 360 to continue to grow and gain more tools and functionality. Autodesk is currently working on a mobile version of Autodesk 360. You can go to the 360 website to sign up for an alert of its availability. By the time this article is released, it may even be ready for us to use. Keep your eye on Autodesk's mobile- and cloud-based programs and services. Many of them will help you in your endeavor to collaborate with others.



Brian Benton is a Senior Engineering Technician, CAD Service Provider, technical writer and blogger. He has over 19 years of experience in various design fields (Mechanical, Structural, Civil, Survey, Marine, Environmental) and is well versed in many design software packages (CAD, GIS, Graphics). He is Cadalyst Magazine's Tip Patroller, AUGI HotNews Production Manager, and Infinite Skills AutoCAD training video author. Contact him at [bbenton@cad-a-blog.com](mailto:bbenton@cad-a-blog.com).



# The Truth about Sharing Inventor Data



Our data is no longer our own. Our drawings are there to give a clear instruction to the next person in the chain. But maybe our drawing isn't enough. Maybe we need to give more.

If we've already taken the time to digitally prototype our design in Autodesk Inventor® before we document it, then maybe we can provide more information—with little extra effort.

When I was merely knee high to a drawing board, my boss impressed upon me the importance of creating quality drawings.

“Paul,” he said, (he remembered my name that day), “we should be able to roll these drawings up, put them in a tube, and send them to Japan, and they should be able to build it.”

And he was right (and still is). But we no longer need to send very thin sections of compressed wood pulp halfway around the world in a tube (also made of compressed wood pulp). We can just send the data.

In this article, we will look at the modern day equivalent of rolling up a set of drawings—Design Web Format (DWF).

We will also look at how to incorporate the Inventor model and BOM (bills of material) into the DWF to ensure that the information set is complete.

Finally we will look at uploading the completed set to the cloud for sharing or review.

Note: if you want to hang out with the cool kids, you need to remember to pronounce it “Dwif!”

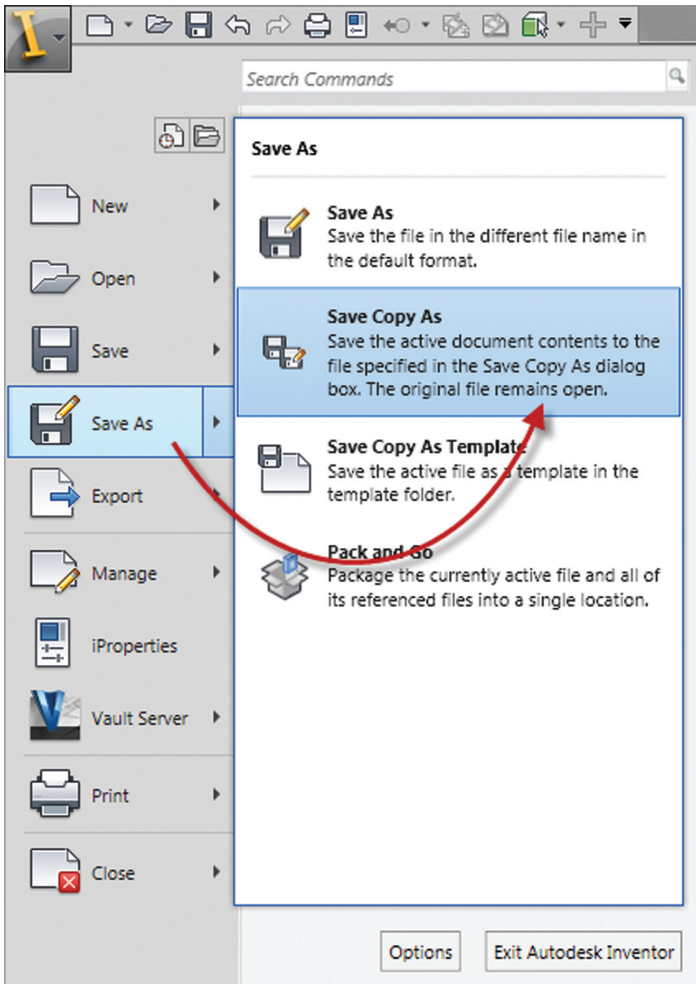
## NOT YOUR GRANDFATHER'S DRAWING SET

Let's start small with “printing” a 2D drawing to DWF. In Autodesk Inventor, go to:

- \* Application Menu > Save as > Save copy as
- \* The 'Save as' dialog will open
- \* Pick DWF or DWFX as the file type
- \* Choose your location and give it a name
- \* Save
- \* Done

Tip: You can also save a DWF using: Application Menu > Export

# Inventor 2013

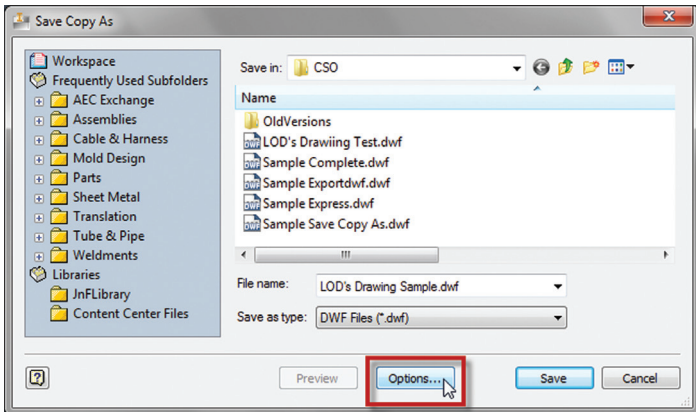


> Export to DWF. This method will show the DWF options first, before taking you to the “Save as” dialog.

## SAVING THE DRAWING AND MODEL TOGETHER

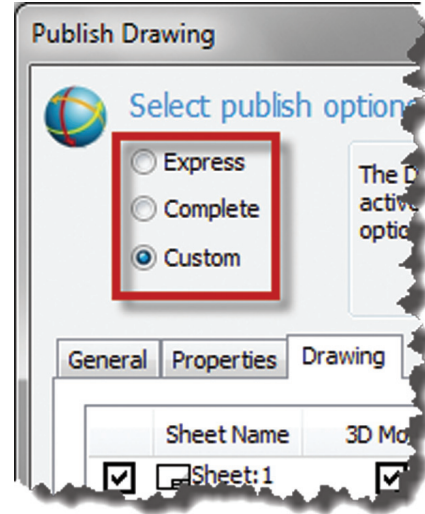
To take a little more control over what is coming out of Inventor, you can use the DWF options.

With the ‘Save as’ dialog open, click on the “Options...” button at the bottom.



The DWF export options give us three choices:

- + Express
- + Custom
- + Complete



Clicking the Express radio button will export only the 2D drawing.

Click the Complete radio button to export the drawing, model (including all views), and BOM (‘structured’ and ‘parts only’, if available).

Clicking the Custom radio button allows you to pick and choose whether or not to include the 3D model and BOM.

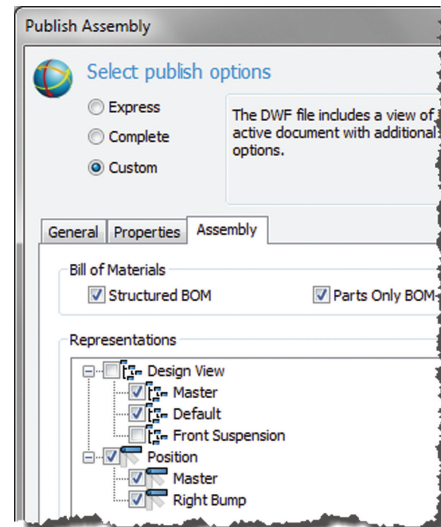
By default, all saved views and both versions of the BOM will be sent to the DWF.

Next, we will look at how to send only the views and BOM that we want.

## SAVING ONLY THE MODEL

If you only want to send a DWF of the model, close the drawing file, open the model file, and go through the same steps.

- + Application Menu > Save as > Save copy as
- + The ‘Save as’ dialog will open
- + Pick DWF or DWFx as the file type
- + Choose your location and give it a name
- + Save
- + Done





Once again, we can refine our output using the 'Options...' button.

We can see the same three options as before. Express sends only the model, Complete sends the model, BOM, and saved views, and Custom gives us a few additional options.

When clicking the Custom button from an Assembly file, we can choose which views and positional reps are sent to DWF.

Note: LODs (Levels of detail) are not available to be included in the DWF.

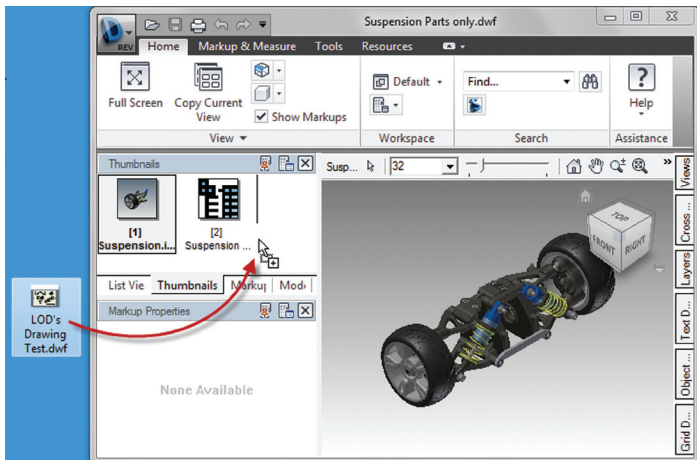
We can also pick and choose which BOM to include—structured, parts only, or none.

## SENDING A DRAWING AND MODEL WITH A LITTLE MORE CONTROL

Unfortunately, the options to pick and choose what views and BOM you want to send are only available when you create your DWF from the Assembly model.

So what if you want to be a little more choosy? It is possible, with this three-step process.

1. Export the 3D model with views and BOM to DWF, using the Custom option
2. Export only the drawing to DWF, using the Express option
3. With the model DWF open in Design Review, drag and drop the drawing DWF from Windows onto Design its Review's Thumbnails tab
4. Save



## IT'S ALL IN THE CLOUD, MAN!

Now that you have your virtual drawing set all rolled up in their 'tube,' how are you going to get it to your collaborator or customer?

You could email it, but that's *sooo* 1990s. These days we host our "DWiFs" in the cloud, dude!

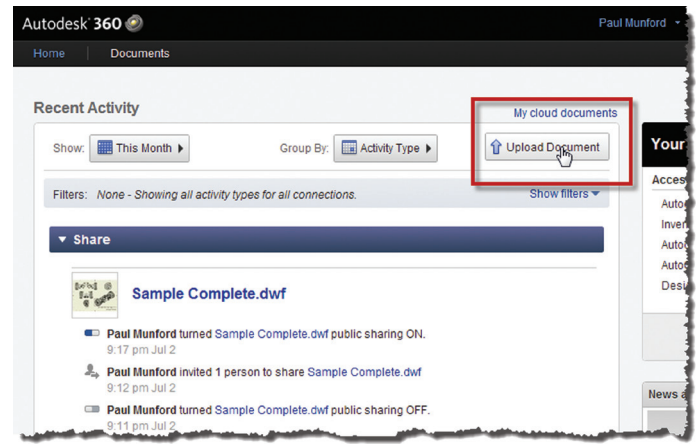
To upload your DWF to the Autodesk cloud, first you will need an Autodesk 360 cloud account. Anyone can have a free Autodesk 360 cloud documents account with 3GB of space available.

Autodesk subscription users get 25GB of space included in their contract. (Figures are correct at the time of this writing.)

Note: If you really want to host a DWF in the cloud, but you don't want to start an Autodesk 360 cloud account, you could try Autodesk Labs Project Quickshare: <http://quickshare.labs.autodesk.com/>

Now that you have logged into your Autodesk cloud account:

- + Click on upload document
- + Drag and drop files onto the window
- + Click upload now
- + Wait (not for long!)
- + Click on 'My cloud documents' to see your uploaded files



It really is as easy as that! And the nice thing is that you can even do some rudimentary document management tasks in the cloud, such as tracking versions of your DWF files.

## INTRODUCING THE MOST EXCELLENT QUICKSHARE VIEWER

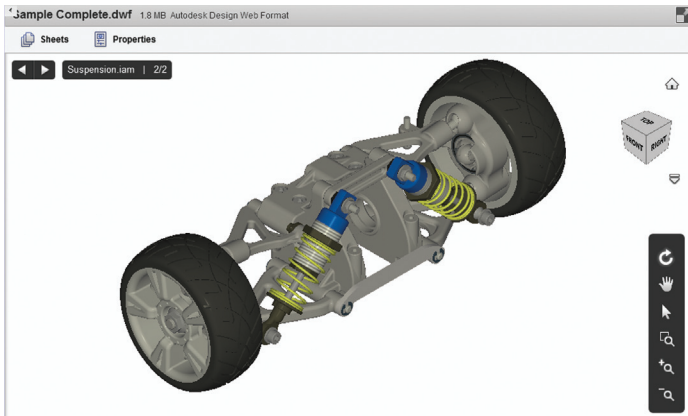
Now that you have your DWF packaged up and hosted in the cloud, it's time to take a peek at it.

This is done with the same excellent viewer that the Autodesk Labs team introduced with Project Quickshare. Just click on your DWF file in the list to open it up in any WebGL-enabled browser. This includes:

- + Firefox 4.0 and higher
- + Google Chrome
- + Internet Explorer 9 and higher
- + Safari 5 and higher



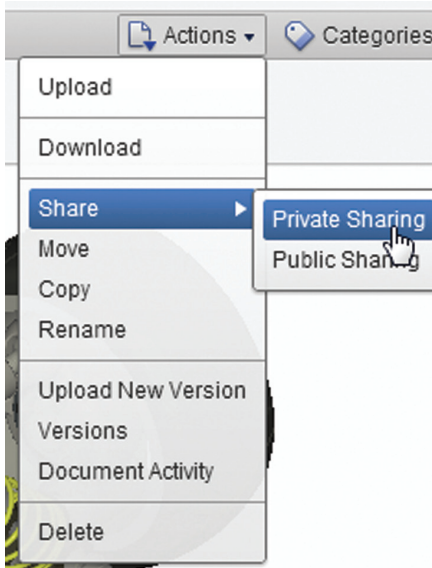
# Inventor 2013



Note: The Design Review app is available from the Apple iTunes store to view DWFs from your 360 account on your iPad: <http://itunes.apple.com/gb/app/design-review-mobile/id459112753?mt=8>

## SHARING IS CARING

If you are happy with what you see, it's time to share. You can share with individuals by choosing: Actions > Share > Private sharing



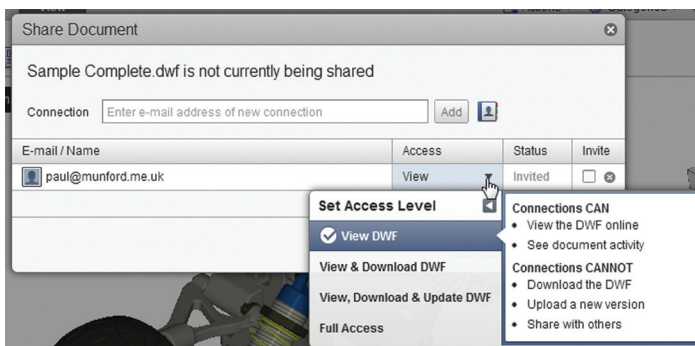
This will pop up a dialog in which to put your colleague's email address.

Click on 'Add' to add the email address to the list of people who can see the DWF.

You now have the option to add a personal message to your colleague.

Tip: This is a good time to review the permission levels that you are granting your colleague.

Click on the fly out under 'Access' to set your colleague's permission to view, download, or supersede the DWF file.



DWF is an application-independent, secure, compressed file format for sharing 2D and 3D data.

DWF is free to create from Autodesk products, and is free to view using Design Review.

DWFX is the latest version of DWF, which has been written to comply with ISO/IEC 29500-2:2008 and Microsoft's XPS (XML paper specification).

DWFX can be viewed on Internet Explorer 7 and above.

Finally, click on 'Save and Invite' to save the new email address to the list of approved viewers and send out an automatic invite email to your colleague(s).

## WHAT'S GOOD FOR THE GOOSE...

If you don't care who sees the DWF file that you hosted in your cloud account, you can turn on public sharing.

Simply click on the Documents tab and click on the toggle control underneath the thumbnail.

You can now email this link to all and sundry, or embed the DWF in your website.

Check out this test version on CadSetterOut.com: <http://cadso.co/MOII33>

Note: The BOM is not visible in the online viewer. Your colleagues will have to download the DWF from Autodesk 360 and use Design Review to interrogate this data.

## CONCLUSION

The world is moving at an incredible pace. The ability to share a drawing set, including 3D CAD files, via your Internet browser seems quite extraordinary to me.

Check it out, have fun with it, and remember to listen to your old boss. He or she might still know a thing or two!



*Paul Munford is CAD manager and a 'Setter out' (a specialist joinery, cabinetry, and millwork drafter), for Halstock joinery in the UK. Paul would tell more stories about his old boss, but people would think that they were fiction. Feel free to contact Paul via his Blog <http://cadsetterout.com/contact/>*





# Best Practices for Collaborating in Revit

**I** have been using BIM on projects since 1998 and from these experiences I have created a list of best practices I follow when collaborating with different design team members. This article, based on a presentation I gave with Erleen Hatfield at Autodesk University, is a collection of some of those best practices that can help ensure a successful BIM project.

Note: The definition of a successful BIM project is one that delivers a good quality product and one that is profitable.

## **PART 1: MANAGING EXPECTATIONS** Establishing and understanding expectations from each design team member

A successful Autodesk® Revit® project goes beyond knowing the technical side of BIM software. There are important topics that need to be considered at the beginning of each project, long before the first element is even modeled. Some of these important topics and questions follow.

August 2012

Revit models contain extensive amounts of rich and intelligent data, and the use and application of these Revit models are virtually endless. Therefore, it is extremely important to establish boundaries for the Revit models with the architect, owner, and contractor. This means that you will need to come to some understanding and agreement on the expectations among team members for what the Revit model contains and what it is to be used for.

Critical questions to ask at the beginning of each project:

- What is the intended use of the Revit model?

Coming to an agreement on the use of the Revit model with the architect, owner, and contractor will establish how much modeling effort there needs to be. Is the Revit model to be used just for architectural and structural coordination, or are there other disciplines involved in the 3D coordination effort? Will the Revit model be part of the deliverable as a contract document from which the contractor will build?

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# Revit Architecture 2013

- What must be submitted at each phase of the project?

Is the Revit model expected to be delivered with the 2D drawings at schematic design? What about at development design and construction document phases?

- Between the architect and the structural engineer, who is modeling what?

The architect, structural engineer, and other design team members will need to come to an understanding about who is modeling which elements in each of their respective models. This could be done via a checklist that simply lists all the elements on the project and then assigns an element to each design team member.

Bear in mind that some elements overlap and more than one design team member may want to model these elements—floor slabs, for example. This checklist will also help establish who is ultimately responsible for the size and location of the elements in the 3D models.

- Is the management, organization, and exchange of the architectural and structural Revit models planned in advance?

A well-planned program between the architect, structural engineer, and other design professionals that establishes how each model is organized and how each Revit model will be exchanged will help the coordination process and eventually create a well-coordinated set of 2D documents.

## PART 2: COORDINATION

### What software products are your clients/consultants using?

The ideal model setup for coordination is for each consultant to use Revit. At the outset of a project, it would be best to identify what software each design team member intends to use so that any problems with interoperability can be foreseen.

During the course of a project, upgrades or changes to the version of a software package can occur. It is best practice to allow for this when dealing with consultants who might not want to upgrade to newer software.

If a design team member is still using something as basic as 2D CAD, it is still perfectly feasible to make use of this kind of information in a Revit model, either as background linework or as lines upon which to trace particular items using some of the native tools for items such as grids, levels, walls, and beams.

### The easiest way to coordinate

The easiest way to achieve efficient coordination is to get all of the design team to agree on a logical structure for the Revit model. This could be achieved via a BIM standards project. Creating project standards for items such as the software in use, file naming, sheet naming, and so on, can go a long way in creating a more efficient environment for the coordination efforts on a large job. This also results in a well-coordinated set of documents between all the design consultants, as shown in Figure 1.

Establishing ownership of items such as gridlines or levels, for example, can really help because the responsibility is maintained by one member. To extend this level of accuracy, using Revit's tools for copy/monitor or clash detection, the other design team members can maintain the same geometry without any errors.



Figure 1: Examples of structural and architectural coordinated sheets.

### How can this be recorded?

When working on very large Revit models that may be set up with Worksharing or Worksets, it is a very good practice to include comments when performing a “Save to Central” so that at particular times the model can be saved to another copy or rolled back if necessary.

Another method to record the evolution of the Revit model is to use reporting tools within Revit to save HTML reports of the interferences in the model. These can be useful to send to consultants to communicate where potential clashes are occurring. The consultant can then use tools such as “Select by ID” to find the pertinent members in the model.

### Coordinating with non-Revit design team members

For very large Revit models, the combination of all disciplines' models may require Autodesk® Navisworks. The use of such software can make it easier to clash check and visualize very large or complex models, especially if some of the design team members are not using the Revit platform.

One of the many useful tools that Revit has for coordination in conditions where a multi-platform BIM is in effect is the use of the 3d DWF file, which is a very lightweight file that can be emailed if necessary.

Revit is able to batch export 2D or 3D CAD files from the model. This can make it very easy to work with non-Revit consultants who require DWG or DGN files for coordination. The export of such files is very streamlined and should be tailored to suit the standard layer and linetype setup for the company CAD standards.

### Dealing with changes

Copy Monitor makes it extremely efficient to modify the design to match new geometry or design options. Setting up the Revit model to look for the latest linked models can make reloading the latest version of consultant's models simple and efficient. This can



be done easily in Revit and basically involves using the “Manage Links” tool to point the linked model at the latest version of a consultant’s model.

Note: Copy Monitor only works on five elements: beams, walls, slabs, grids, and levels.

When working with a new model from a consultant, it is definitely a best practice to utilize whatever new grids or levels have been created or modified in their model. These items are the cornerstones of BIM and should be maintained accurately, which is very easy to do if using Copy Monitor.

### Who owns what? The new area of BIM contracts

With BIM technology maturing, new issues are appearing. One of these involves the determination of who owns the final Revit model. Deciding who will be ultimately responsible for the complete model at the conclusion of a project, or who will be maintaining as-built models for the project, will help avoid repeat work or unnecessary survey work.

Other decisions that are critical to efficiency are items such as whether the fabricator or detailer will be working from the model. Also, the consequences of sharing the digital model with the contractor could have a positive influence on the communication of the design and execution on site.

These issues should be covered in the contracts for BIM projects so that lines are set up for each member of the design team. Our office sets all this language in the terms and conditions of each contract and it is also referenced in the general notes of the contract documents.

## SUMMARY OF METHODS FOR WELL-COORDINATED DOCUMENTS

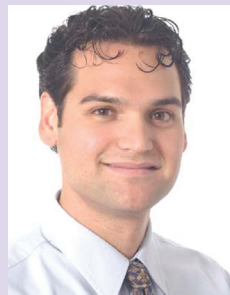
- Set up linked views that show only specific elements and control this with view templates in each design team’s Revit model. This way, when the models are linked there no extra elements showing.
- Consider project size before linking/importing.
- The modeler should be aware of the frequency of revisions (weekly, bi-weekly?) of the other models.
- Origin (0,0,0) should be maintained throughout all design team members’ drawings. This is much more crucial than in 2D drawings.
- The standard organization can work for smaller projects, but custom organization may be necessary for larger, more complex projects.
- Customize for intuitive understanding by others who may work on the model.
- Use “Project Parameters” and apply to Views for custom organization (e.g., “For Reference Only” or a separation of “Perspective” and “Orthographic” 3D views may be necessary).
- Keep in mind that copy/monitoring elements depends on the project and that there is no absolute standard.
- Consider the fact that the party responsible for the geometry (e.g., slab outline - architect) may be different than the party

responsible for its properties (e.g., slab thickness and reinforcement – engineer).

- Coordination Review can be used only after copy/monitoring is set up and there will even be an automatic notification.
- Create/save the HTML Coordination Review Report once Coordination Review is completed, then export to Microsoft Excel format. Excel allows better organization and manipulation of data.
- Identify the person responsible for the “actions” (manager or modeler). Do not ignore the “add comments” option for recordkeeping purposes.
- Exporting to AutoCAD® is useful for design team members who do not use Revit.
- 2D DWF may work better than 2D PDF for simpler viewing and printing.
- When exporting to 3D DWG, check the level of detail (e.g., Coarse, Medium, and Fine). Structural members in fine detail show even the fillet radius, adding additional geometry that may not be necessary.
- 3D ADT exporting from Revit may not recognize all Revit objects such as foundations and coping of structural members.

## FINAL THOUGHTS

Hopefully, after reading this article you have picked up some useful tips on how to effectively and efficiently collaborate among the different design team members. There are too many tips to list them all here. Good luck, and I hope all of you have successful, productive, well delivered, and profitable BIM projects.



Marcello Sgambelluri is the BIM Director at John A. Martin & Associates Structural Engineers in Los Angeles, CA. He has been using Autodesk products for over 15 years including AutoCAD, 3ds Max, and Revit Structure. He is a member of the ASCE-SEI BIM committee and continually speaks at structural professional conferences across the country. Marcello teaches classes regularly at Autodesk University that focuses on free form modeling in Revit and he beta tests the yearly releases of Revit Structure. He has worked on many projects that incorporated complex geometry including the Walt Disney Concert Hall in Los Angeles, CA, the Stata Center at MIT, and the International Terminal Expansion at LAX. Marcello received B.S. and M.S. degrees in Civil Engineering and is a licensed Civil and Structural Engineer. He can be reached at [marcellojs@johnmartin.com](mailto:marcellojs@johnmartin.com).

# Collaboration With Autodesk Design Review 2013



**A**utodesk® Design Review 2013 is a free program used to create and review Design Web Format (DWF) files. DWF is an open, published, and secure file that enables you to combine and publish 2D and 3D design data and share it with others. Much like Adobe PDF files, DWF files are no more alterable than printed paper copies. However, unlike PDF files, DWF files retain detailed design information and scale. This makes them more suitable for architects, engineers, and designers.

When DWF drawings are marked up in Autodesk Design Review, you can then view these markups in AutoCAD® Architecture and make changes to your drawings.

How does this work? When you want to submit designs for review, you can publish a DWF file from AutoCAD Architecture and then send it to the reviewer of your designs. The reviewer can open the DWF file in Autodesk Design Review, markup the file electronically, and then send it back to you. When you open the marked-up DWF file in AutoCAD Architecture, you can view

the redline markups in the AutoCAD Architecture drawing area, turn them off, make your changes, and republish the DWF file to send out for another review. Doing all this electronically with AutoCAD Architecture and Autodesk Design Review greatly decreases the time normally spent in collaboration with others.

## PUBLISH DRAWINGS FOR REVIEW

Once your design is complete in AutoCAD Architecture, it is time to publish the drawings for review. So that electronic markups created in Autodesk Design Review can align with the original drawing geometry, it is important not to change elements in your drawing file that can affect this alignment after you have published the DWF file for review. These elements include the following.

- Layers and layer states
- Layers to which objects are tied
- View rotation
- Number and placement of viewports in layouts
- Position and scale of objects within viewports

To publish a drawing set in AutoCAD Architecture to a DWF file, select the main menu drop-down, print menu, and then select



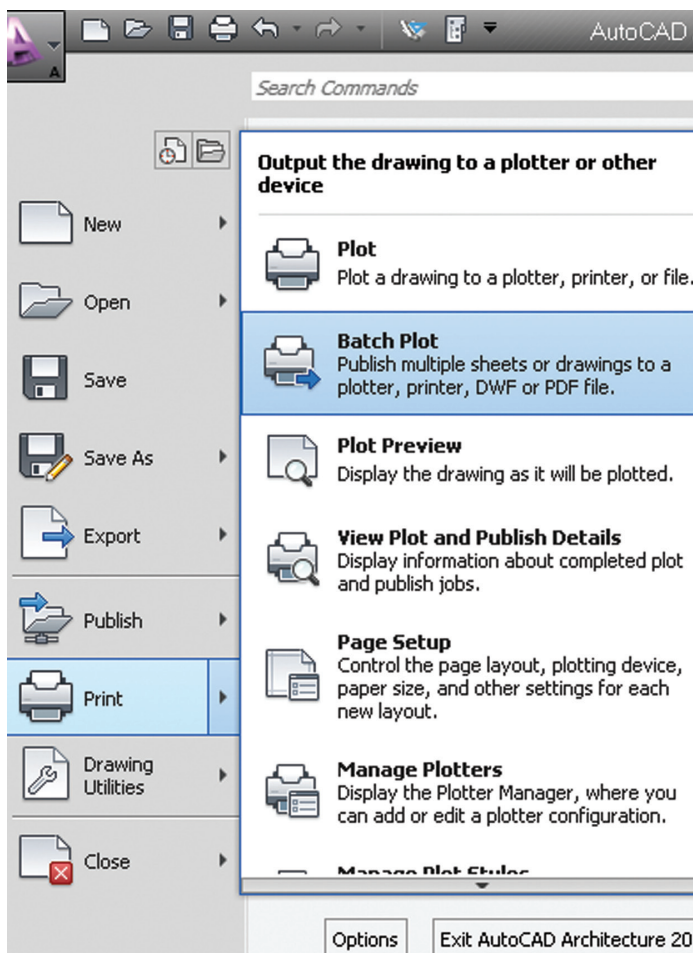


Figure 1: Batch plot

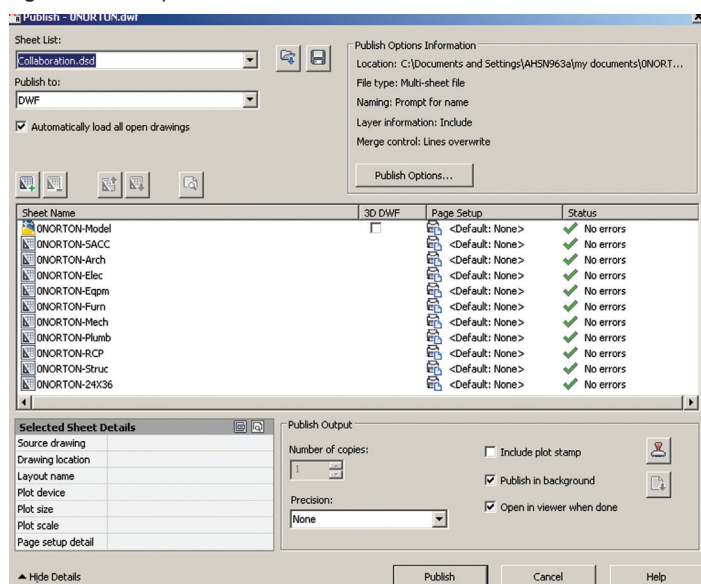


Figure 2: Publish dialog box

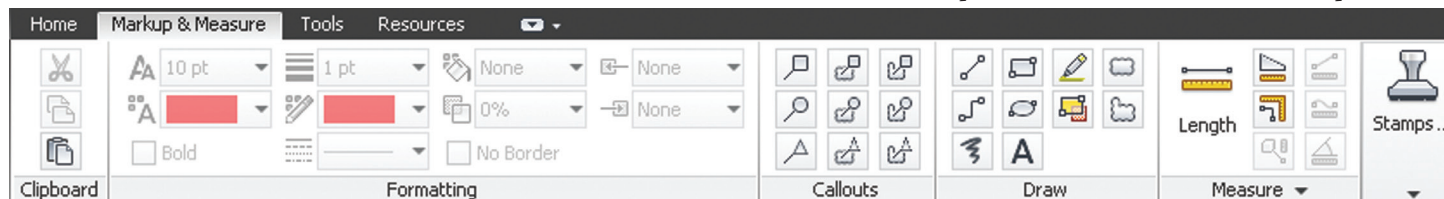


Figure 3: Markup & Measure tab

Batch Plot (see Figure 1). This brings up the Publish dialog box. If the Automatically Load All Open Drawings option is selected in the Publish dialog box, all the layouts in the current drawing are listed in the sheet list. You can modify the list of sheets in the Publish dialog box as needed.

When your list of drawing sheets is assembled and configured the way you want for your drawing set, click the Save Sheet List button (see Figure 2). In the Save List As dialog box, enter a name for the list in the File Name box and then click Save. The drawing set list is saved as a drawing set descriptions (DSD) file. Now, in the Publish dialog box, under Publish To, select DWF File. Then click Publish. Next, in the Specify DWF File dialog box, enter a file name. The Files of Type is DWF based on the selected DWF format. Click Select to provide the name and destination for the DWF file. Click Save to start the electronic drawing set creation.

## INSERT MARKUPS

A markup can be either a single comment or a redline geometry correction that is inserted into a DWF file. Once the AutoCAD Architecture drawing has been published for review, you can use Autodesk Design Review to add markups electronically, just as you would mark up a paper version of the drawing. You can also assign a status to the markup and add comments. After you have made the markups you wish to make, resave the DWF file. Now the markups can be viewed and corrections made. Markups can be made using the Markup & Measure tab on the ribbon (see Figure 3).

## SECURE MARKUPS

Design Review enables you to lock and unlock markups, which helps prevent accidental changes and deletions. Locking a markup prevents several actions such as cutting, deleting, moving, and modifying text. However, not all changes are disabled when a markup is locked. Locked markups do not prevent changing formatting and properties. After creating new markups, they remain unlocked and you can manually lock and unlock markups as needed. When a marked-up DWF file is opened, all existing markups are locked. You can determine whether a markup is unlocked or locked by looking at the grips. On the canvas, the grips of a selected markup are either yellow, indicating unlocked, or gray, indicating locked. You can also look at the Markups palette. To the left of each markup, a lock icon indicates whether a markup is unlocked or locked.

If you wish to change the security of a markup, begin by clicking Select on the Canvas toolbar. On the Canvas or in the Markups palette, select the desired markup object. To lock the markup, click the unlocked icon in the Markups palette to the left of the markup name or, on the canvas, right-click the markup and select Lock. The selected markup is now locked. To unlock a markup, click the

# AutoCAD Architecture 2013

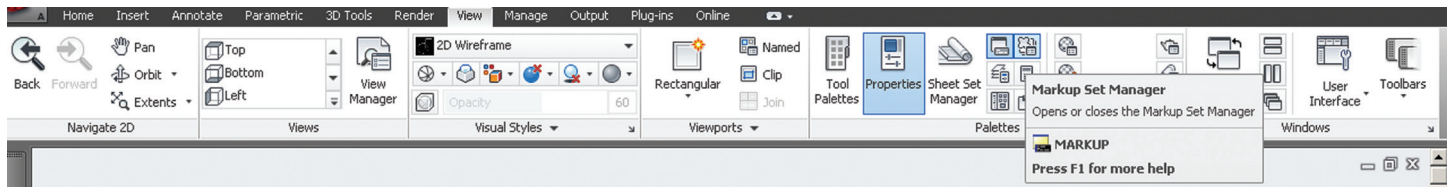


Figure 4: Markup Set Manager

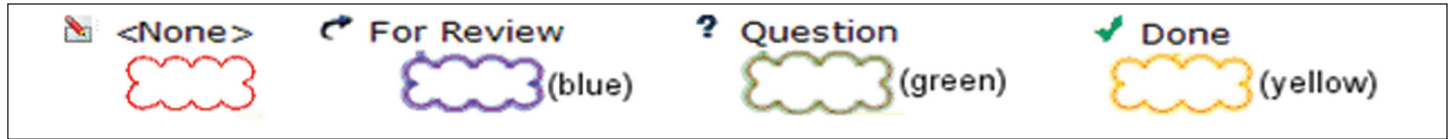


Figure 5: Color-coded markups

locked icon in the Markups palette to the left of the markup name or, on the canvas, right-click the markup and select Lock. The selected markup is now locked. You can also double-click a locked markup on the canvas to unlock it.

## VIEW MARKUPS

Now that you have received markups, it is time to review them so corrections can be made. To view the markups in your designs, load the markup set into the Markup Set Manager. A markup set is a group of markups contained within a single DWF file. To open the Markup Set Manager, select the View tab on the ribbon in AutoCAD Architecture, then click the Markup Set Manager button on the Palettes panel. This brings up the Markup Set Manager palette (see Figure 4).

Now, in the Markup Set Manager, click the Markup Set list control and select Open. When you load a markup set into the Markup Set Manager, the tree view will display each marked-up draw-

ing sheet and its associated markups. It is important to note that if you try to load a markup set by opening a DWF file that does not contain markups, you will not be able to open the DWF file in AutoCAD Architecture. You can, however, open the DWF file in the DWF file viewer.

While in the Markup Set Manager, you can view details of an individual markup. To do this, click on an individual markup node. The Markup Details area in the lower portion of the Markup Set Manager will display details for the selected markup. These details can include the creator of the markup, the date and time it was created, and any comments associated with the markup. Markups are color-coded and have icons that are specific to their status (see Figure 5).

When you double-click a model space markup in the Markup Set Manager, the original drawing file opens in model space. The drawing automatically reverts to the view rotation that was current when the drawing was published. Please note that if you then change the view rotation, the markups will not be shown in the drawing until you double-click a model space markup and revert to the published view. Also note that visual style and Shademode must be set to 2D Wireframe.

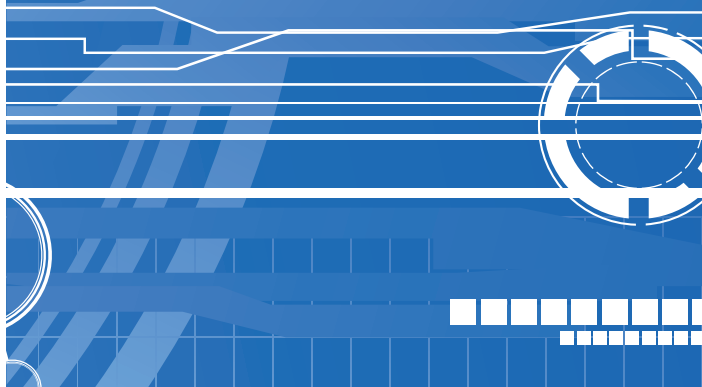
The Markup Set Manager allows you to specify what is displayed in the drawing area. You can show or hide the originating drawing file, the reviewed DWF file geometry, and the redline geometry. This allows you to view the redline geometry, turn it off to make the changes in your drawing file, and then view the redline geometry again in AutoCAD Architecture to check your corrections.

If you wish to hide DWG geometry for drawing sheets with associated markups, click the View DWG Geometry button. You can click the same button again to show the DWG geometry. If you wish to show DWF file geometry in the drawing area, click the View DWF Geometry button to show the DWF geometry. You can click the same button again to hide the DWF geometry. If you wish to show or hide redline geometry (markups) in the drawing area, click a markup node to view the redline geometry in the drawing area. Then click the View Redline Geometry button to hide the redline geometry. You can click the same button again to show the redline geometry.

**UNLIKE PDF FILES,  
DWF FILES RETAIN  
DETAILED DESIGN  
INFORMATION AND  
SCALE. THIS MAKES  
THEM MORE SUITABLE  
FOR ARCHITECTS,  
ENGINEERS, AND  
DESIGNERS.**



**IF YOUR COMPANY IS THINKING ABOUT “GOING GREEN,” AUTODESK DESIGN REVIEW IS A PERFECT SOLUTION TO STOP PRINTING ALL THOSE PAPER DRAWINGS FOR MARKUP AND REVIEW.**



## RESPOND TO MARKUPS

Now that you have reviewed markups, you can change their status and add comments that are saved with the markup. In the Markup Set Manager, select an individual markup in the tree view and the Markup Details area displays information about the markup. In this area, you can change the status of the markup or you can right-click on a markup and select an option on the Markup Status shortcut menu. You will notice that the default status for new markups is <None>. A markup's status can be changed to Question, For Review, or Done.

In the Markup Set Manager, you can add comments or notes for the selected markup in the Notes area under Markup Details. Changes in markup status as well as added comments are automatically saved in the DWF file and are included when you republish it. Markup changes can also be saved by right-clicking the markup set node and clicking Save Markup History Changes on the shortcut menu.

## REPUBLISH A MARKUP SET

After you have viewed a markup set and made necessary changes to your drawings, you can then republish the markup set for another review, if needed. It is important to note that when you republish the markup set, the markups and any changes that have been made to them are saved in the DWF file. When anyone reviews the republished DWF file in Autodesk Design Review, the changes that have been made to the drawings are visible, as are any changes that have been made to the status and the details of the

markups. If you republish a DWF file that has had sheets deleted from it or rearranged within it in Autodesk Design Review, the new order of sheets will be reflected in the republished DWF file. However, if any sheets were added to the DWF file in Autodesk Design Review, those sheets will not be included in the republished DWF file.

To republish a markup set, click the Republish Markup DWF button at the top of the Markup Set Manager. Next, select one of the following:

- + Republish All Sheets – Clicking this option republishes all sheets within the marked-up DWF.
- + Republish Markup Sheets – Clicking this option republishes only those sheets in the marked-up DWF file that have associated markups.

Then, in the Specify DWF File dialog box, select a DWF file or enter a name for the file and click Select. By default, the previously created marked-up file name is displayed and is overwritten with a file of the same name that contains the drawing and markup changes.

## PRINT A DRAWING WITH MARKUPS

If you desire, you can print a drawing with markups. Begin in Windows Explorer and double-click a DWF file that contains markups. The DWF file will open in Autodesk Design Review. You can then print the marked-up DWF file.

## CONCLUSION

When you are in the final stages of a design, drawings can be published for review. Then you can receive corrections and comments electronically. These can then be implemented and you can respond to these comments and then republish your drawings. Doing all this electronically streamlines communication and results in a more efficient design process.

What better way to accomplish this than through the use of AutoCAD Architecture and Autodesk Design Review? If your company is thinking about “going green,” this is a perfect solution to stop printing all those paper drawings for markup and review.



*Melinda Heavrin is a CAD Coordinator & Facility Planner for Norton Healthcare in Louisville, Kentucky. She has been using AutoCAD Architecture since release 2000. Melinda can be reached for comments and questions at [melinda.heavrin@nortonhealthcare.org](mailto:melinda.heavrin@nortonhealthcare.org).*

# Doctor Who and the CAD Manager



**F**or those of you not familiar with Doctor Who, he is a character in the long-running BBC series of the same name. He is a time traveler. Truth be told, I'm not that familiar with the show or the good doctor, but I do my fair share of time traveling so I feel a certain kinship.

You're likely thinking, what is this guy talking about and what does any of this have to do with CAD management? Time, actually. You've heard the cliché "Time is money," and perhaps you agree with that. Now I'm not a disagreeable person, but I take issue with this particular cliché. You see I believe time is money \* n, or money ^ n or perhaps time is money exponentially. All right, you can see I'm not a math whiz, but I'm trying to say if you were to look at every little micro or nanosecond of nonproductive time and multiply that across all people in an organization, pretty soon it adds up to a significant amount of cash.

Well, you can't really look at all those non-productive nano or microseconds or, for that matter, seconds or even minutes, but you sure can examine the accumulation of them. Furthermore, who is to say what is or isn't productive time? Maybe you don't even bother.

With a competitive global economy nipping at everyone's heels, perhaps now is the time to bother. Possibly the head honcho has decreed that you have to raise your department's efficiency. You're under pressure to meet this or that impossible deadline. Maybe your current design and drafting standards need updating or you are thinking of moving from AutoCAD® LT to the full version. Perhaps you are examining a move to 3D modeling. Do you stay with AutoCAD® or do you make a switch to Autodesk Inventor®, AutoCAD® Civil 3D®, or Autodesk® Revit®? Thinking of a move to the cloud? Where do you start?

Don't.

Before you do anything, or make any changes, assess where you are. I don't mean a mental assessment—you can easily be deceived by your own brain (I do it all the time). Take a hard look at your current costs by monitoring the time component of your current drawing or model creation processes, personnel, methods, and so on. How long does it take to prepare a drawing of a certain type, or to prepare a bill of material? Is one designer or drafter faster when working on a blue widget and another quicker working on green gadgets? Until you know where you currently are, it will be difficult to establish goals for where you want to be. For these reasons you'll want to begin establishing some benchmarks.



If you don't mind a journey into the past, jump into the TARDIS with me and let's travel back about 20 or more years. I'll share some experiences that may help you get a grip on your current costs (where your users' time is spent) and how those costs might be brought down. Ready?

Our first stop is 1991. I had recently been successful in landing an independent design and build for a new machine I had proposed to a potential client. Striking out on my own I wanted to become as efficient as I possibly could. My first decision was to select AutoCAD as my drafting platform. The price of AutoCAD was within my means, but most importantly, I learned AutoCAD came with the AutoLISP programming language. I had never heard of AutoLISP, but I had some previous programming experience and figured it could not be that difficult to learn. I was right.

Now I needed to begin logging my time for work being done and my first inclination was to use AutoCAD's TIME function to study the amount of time I spent working on my designs and drafting. I found the command to be woefully inadequate. Not only did I discover the "edit" time was merely an accumulation of the amount of time that a drawing was open, but I also discovered that the time was carried over from one drawing to another when performing certain file saves or starting a drawing from other drawings that had previous accumulated time. My conclusion was that's not going to work well.

I soon worked out an AutoLISP program that allowed me to get a true picture of the time spent on my drawings, both the actual edit time and the total elapsed time. This provided me with the means to establish a rough idea of my efficiency and productivity.

\* SEE BACK

S.O.	Tool #	Customer	Tool Name	START DATE	FINISH DATE	START DATE	FINISH DATE	ELEC. SER.	PAID - REG. CHARGE	LAYOUT HOURS	DETAIL HOURS	CHECK HOURS	TOTAL HOURS	FORECAST HOURS	9/15	22/24	12/19	6/11	13/13	1/3	1/4	12/19	7/19	4/7	12/11	4/5	12/25	9/30	12/12	11/25	0/7
8900	T-60000-50	FUJI	ASSM. ACCEL. PEARL	11/28/91	11/28/91	11/28/91	11/28/91	X	-	35	30	6	71	50	9	22	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
8927	T-60021-53	FUJI	ASSM. SW. 1 MOBL TO HAND GRAB SEAT ADJ. ARC WELD FIXI	11/28/91	11/28/91	11/28/91	11/28/91	X	-	92	51	12	155	185	22	24	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5129	T-43543-54	TOYO	BRK. SWAP. PLATE	11/28/91	11/28/91	11/28/91	11/28/91	-	-	20.5	45.25	9	74.75	60	12	19	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5157	T-43544-57	TOYO	ARC WELD FIX. BRK. SWAP. PLATE	11/28/91	11/28/91	11/28/91	11/28/91	-	-	20	11.50	3	34.5	60	12	19	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5157	AVM-6075 MACH.	TOYO	UNLOAD STA.	11/28/91	11/28/91	11/28/91	11/28/91	-	-	15.5		4			12	19	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5129	AVM-6076 MACH.	TOYO	CLAMP & GROUND	11/28/91	11/28/91	11/28/91	11/28/91	-	-	31	14	3.5	48.5	50	13	13	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
8588	T-43294-4	CHR.Y.	STAKE LOWER TRC-RSIR	11/28/91	11/28/91	11/28/91	11/28/91	-	-	8	3	1.5	12.5	40	1	3	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
8588	T-43294-5	CHR.Y.	REPOSITION LOWER TRC-RSIR	11/28/91	11/28/91	11/28/91	11/28/91	-	-	5	6	1.0	12.0	20	1	4	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5362	T-43637-55	B.O.C.	PARENT METAL STAKE	11/28/91	11/28/91	11/28/91	11/28/91	-	-	42.5	41.5	8	92	40	12	19	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5164	AVM 6078	TOYO	INLINE TRANS. STA. 2	11/28/91	11/28/91	11/28/91	11/28/91	-	-	40	17	5	62		7	19	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
"	AVM 6078	TOYO	STA. 7	11/28/91	11/28/91	11/28/91	11/28/91	-	-	10	11.5	2.5	24		4	7	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
"	"	"	STA. 8	11/28/91	11/28/91	11/28/91	11/28/91	-	-	23.5	21.5	4.5	49.5		12	11	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
"	"	"	STA. 9	11/28/91	11/28/91	11/28/91	11/28/91	-	-	20.0	4.5	1.5	26		4	5	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
"	"	"	STA. 17	11/28/91	11/28/91	11/28/91	11/28/91	-	-	45.5	44.5	8.0	98		12	25	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5855	T-44100-02	"	PRESS BALL	11/28/91	11/28/91	11/28/91	11/28/91	-	-	31	45.5	16.5	93	60	9	30	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
5852	T-44086-95	"	PRESS GROMMET	11/28/91	11/28/91	11/28/91	11/28/91	-	-	34	13.0	3	50	40	12	12	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
6601	T-60704-02	GSA	PROD. WELD	11/28/91	11/28/91	11/28/91	11/28/91	-	-	90.5	31.0	12.5	80		11	25	12	6	13	1	1	12	7	4	12	4	12	9	12	0	
6593	T-60710-55	GSA	ASSY. FIXTURE	11/28/91	11/28/91	11/28/91	11/28/91	-	-	28.0	9.5	33.5	46		0	7	12	6	13	1	1	12	7	4	12	4	12	9	12	0	

Figure 1

Why only rough? There are other factors that enter into design and drafting. For instance, reviewing reference material, whether it be books and catalogs (hey, this was pre-Internet), consulting with shop personnel about how best to machine something, and meetings or phone calls with vendors to discuss a particular component. The list goes on, and all happening while the drawing was open and adding up those seconds.

I first established some goals, taking into consideration my current standards, methods, prior knowledge of my work output, and so on. Wait, let's get back in the TARDIS and dial it back a couple more years—back to when I was employed as a machine designer.

Earlier, I mentioned that you need to know where you are to determine where you want to be. A benchmark is needed and before moving to CAD I had manually kept some records of my time when I worked on a drafting board. I would record the number of hours to design and lay out a machine, noting the number of manufactured details and commercial components. I then recorded the time spent detailing the components and finally the time to check. See Figure 1 for some of my original recordings.

Toward the end of my employment we had begun doing some CAD work and I highlighted those with the hashing. You should

be able to see the time was higher on those jobs, a result of the CAD learning curve. Studying my recordings of various projects I determined that total job time for much of the design and detail work came to approximately five hours average per manufactured component. I was also able to establish an average percentage of the job total to the type of work (design and layout, detailing and checking). Armed with this previously collected data, I was ready to begin my quest for improved productivity and see if the bar could be raised.

From these logs I created the following spreadsheet to help visualize my work effort and output. This would serve as a benchmark to measure against as I massaged my AutoCAD standards, drafting techniques, and customized AutoCAD work environment.

By studying the spreadsheet in Figure 2 you will see I've graphed (in blue) the total job time which is the sum of layout, detail, and checking time per the sum of manufactured details and commercial components. Also graphed is the total job time (yellow), layout time (green), and detail time (beige) per number of manufactured details. My main area of interest was the number of detail manufactured parts, primarily because that was where the more original thinking was required.

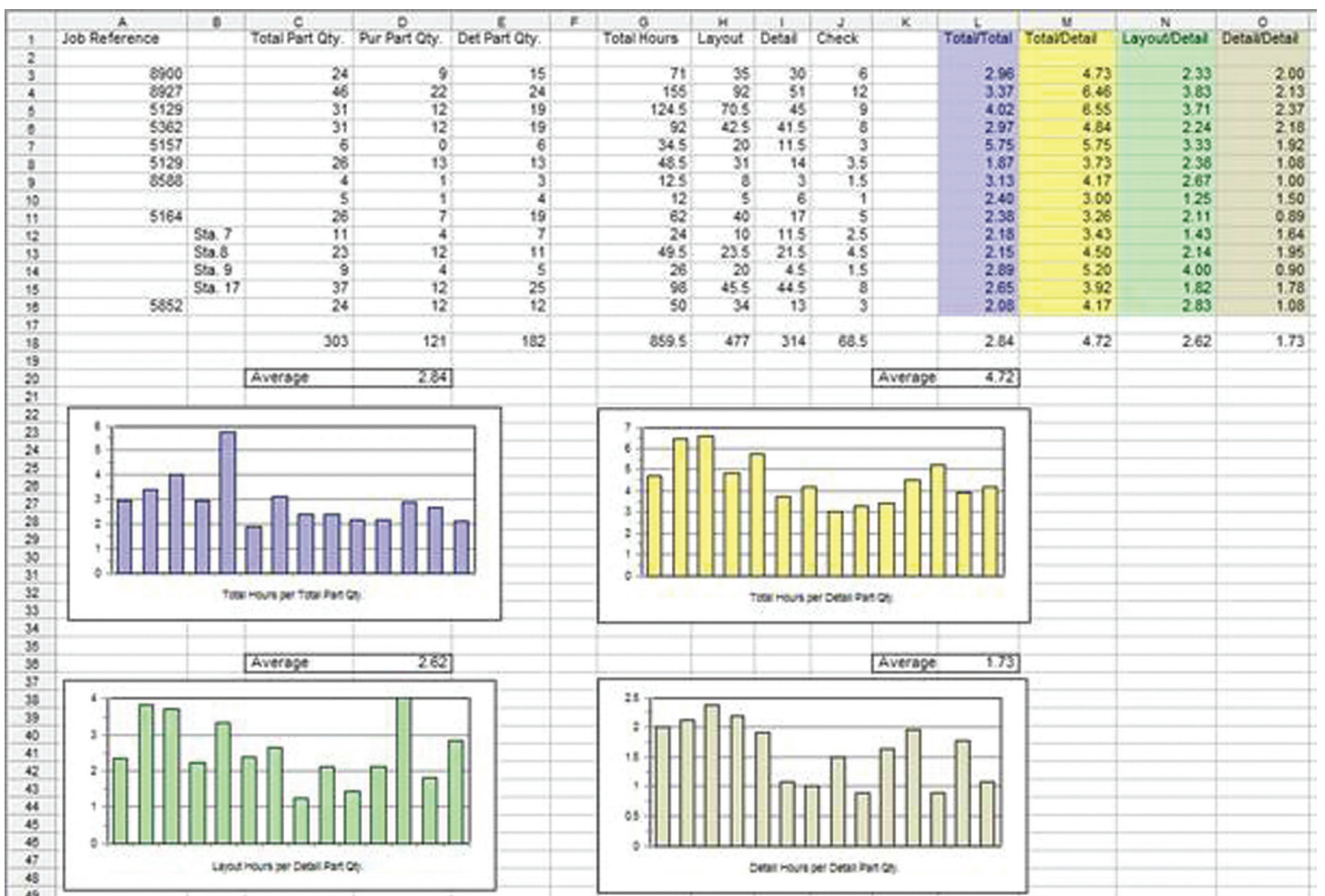


Figure 2: Manual board drafting



EDSACAD SYSTEM DEVELOPMENT	
3-24-92	AGGVAL
5-11-92	WLAYER
6-10-92	CHART
6-18-92	RESTRUCTUREL SYSTEMS ; MENU ; LAUNCH BATCHES ; ETC
7-2-92	ESORT (AUTO VIEW GENERATION)
8-16-92	XPLDOL ; REMOVE EXPOSED ENTITIES TO LAYER OF HIGHLIGHT REMOVE 3D FASTENERS
8-19-92	IN/OUT ROOM ; ROOM ; ZONEPLDOL ; PINKPLDOL
10-31-92	IMPROVEMENTS TO SQUASH
11-1-92	IMPROVEMENTS TO SQUASH
11-18-92	INLAY
1-30-92	IMPROVEMENTS TO BOX & CYLINDER MENU ITEMS
2-5-92	ORDINATE
2-10-92	MARK - CATCH
2-23-92	ADD DOT ; ANG ; UPDATE UNITS TO DIM ; PULLDOWN ; ADD ANGLE MID ; END ; DIM ; TO EDIT ; PULLDOWN ; ADD TEXT ; MARK-CATCH TO MENU ; ADD BRDOUT
2-27-92	IMPROVEMENTS TO XPLDOL (TO SPECIAL MARKED ANGLES)
3-1-92	IMPROVEMENTS TO SQUASH ; ORDINATE - BEGIN USING BATCHWISE LISP FOR SQUASH
3-11-92	PRESENT INSERT
3-18-92	AUTODOC ; SQUASH
3-19-92	TEMPLAY ; IMPROVEMENTS TO SOLAY ; IMPROVEMENTS TO SQUASH
4-7-92	IMPROVEMENTS TO 3DXPLDOL
4-23-92	TIMEKEEP
5-29-92	IMPROVEMENTS TO AUTODOC ; I ; W ; P
5-30-92	IMPROVEMENTS TO PREINSERT ; L ; B ; S ; Z ; I CREATE PROSERT ; L ; B ; S ; Y ; Z ; I
6-2-92	CREATE AUTODIM ; T ; L ; H ; V ; R ; S ; R ; A ; S ; U ; Z ; L ; G ; R ; T ; O ; I ; Z
6-5-92	CREATE PREINSERT (RENEW)
6-18-92	IMPROVEMENTS TO : XPLDOL ; 3DXPLDOL ; PINKPLDOL ; AUTODIM
6-30-92	IMPROVEMENTS TO SOLAY ; TEMPLAY

Commercial parts were more quickly drawn due to having dimensional information or it was a matter of simply tracing over a template. I did not attempt to differentiate between the complexity of the detailed parts such as a weldment or a spacer plate—I was interested in establishing an average. To a certain extent that explains the peaks and the valleys as some jobs had a greater number of complex parts, some fewer. The end result of this exercise, as you can see, is a typical job required 4.72 hours to complete per manufactured detail and the average time to detail was 1.73 hours per detail. For charting, checking time was not included so you'll notice a slight disparity in the total hours per detail part.

Starting out fresh I had much to do—selection of a computer (my first “real” one), self-taught AutoCAD and AutoLISP learning, supporting software selection, printer, file cabinets, and more—too many details to bore you with. The main focus was on designing and building the machine to which I was committed. Until that was complete, the search for increased productivity was placed on the back burner.

With that in mind let's jump back into the TARDIS and dial in the year 1993.

Figure 3

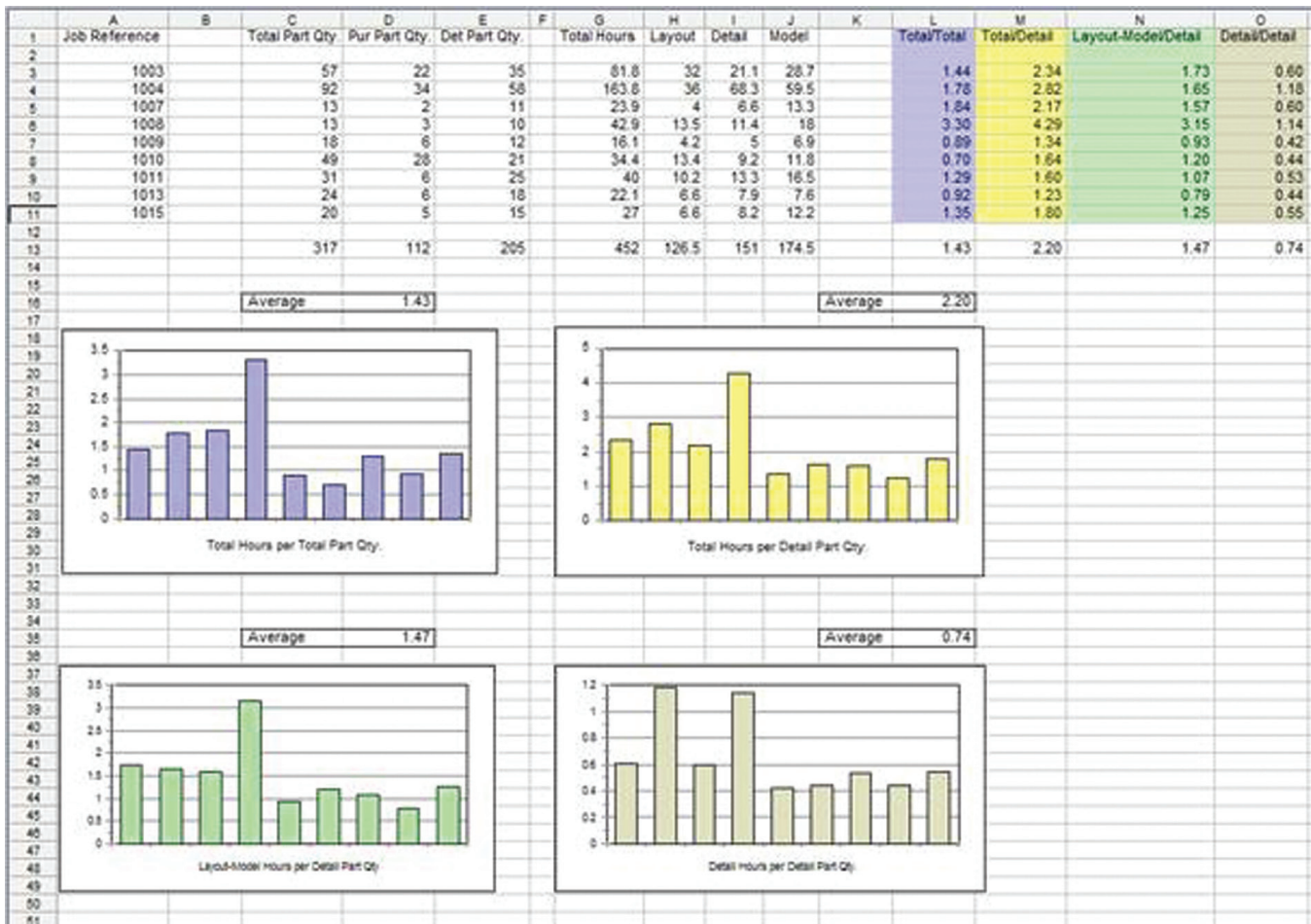


Figure 4: AutoCAD modeling and drafting benchmark

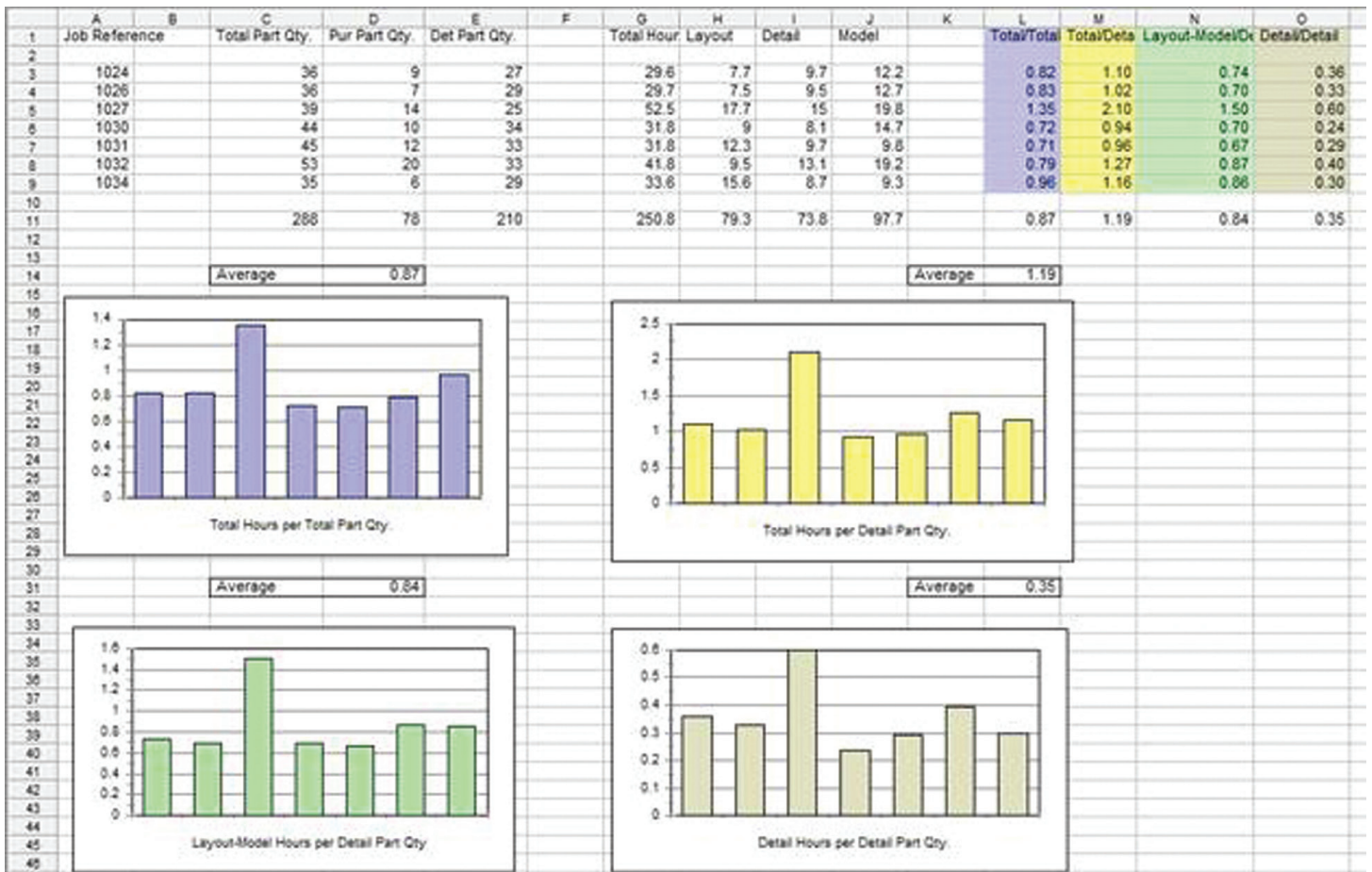


Figure 5: AutoCAD benchmark comparison

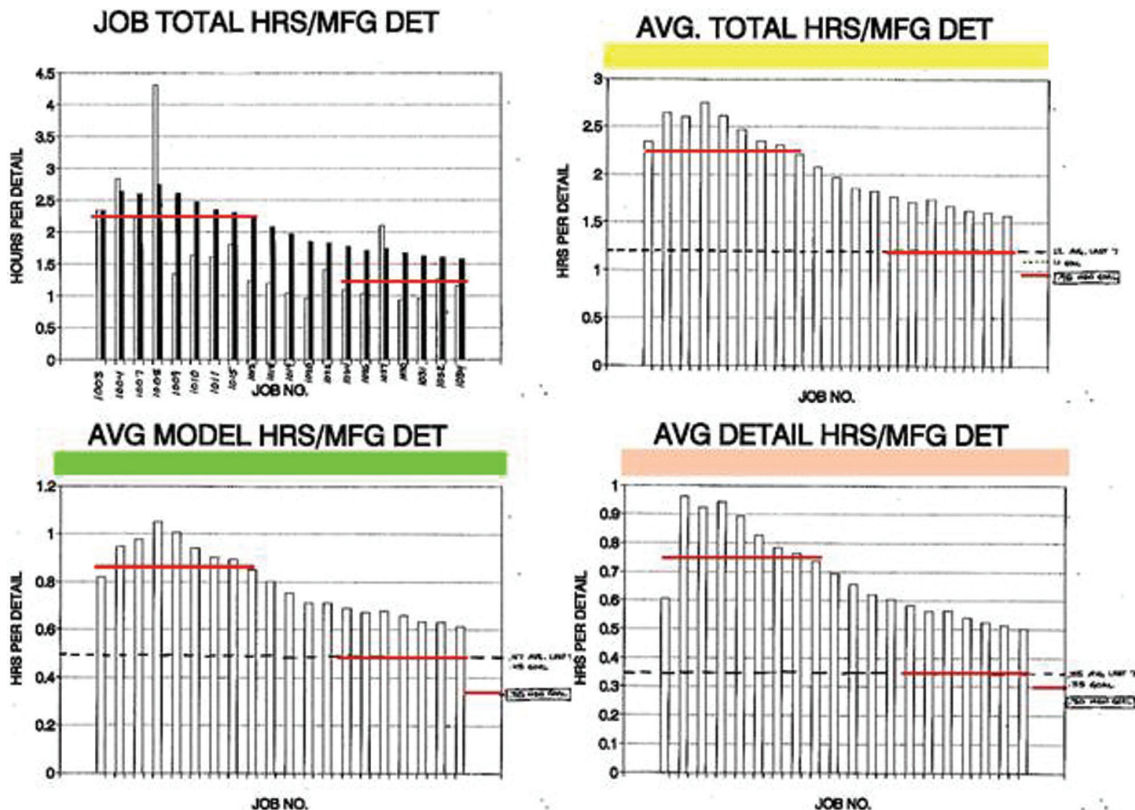


Figure 6: AutoCAD goal set



I was pretty busy during the intervening two-year period. Completion of the machine design and build, additional design jobs, and many AutoLISP routines to write for tweaking my system as shown in Figure 3.

Now I had several AutoCAD jobs under my belt to make some comparisons, although the first few jobs were not recorded. Those that were recorded would offer some insight as to how things were developing. The spreadsheet in Figure 4 was created in July 1993.

I used metrics similar to those I had previously; however, checking was no longer recorded, I abide by the old principle of measure twice, cut once. After a design was completed with numerous amounts of LIST and DIST commands, checking was redundancy upon redundancy. You will also note I grouped modeling in with layout. Mind you, it was not true modeling—at the time I was constructing my models as simple 3D wire frames. In fact, all my construction was done with just lines, circles, and arcs. I had determined that polylines were memory hogs in AutoCAD and they were more difficult and time consuming to work with. Bottom line is a typical job now required only 2.20 hours to complete per manufactured detail and my average time per detail was down to .74 hours.

The takeaway from this is the CAD software vendors were right—CAD is more efficient than manual drafting; however, I can attribute much of the productivity gains to the methods and customizations that were implemented. Specific dates are not indicated on the charts, but I'm certain you can determine the point at which many of the changes took effect.

Now it was time to discard the old benchmark and replace it with a more current one, one that reflected strictly AutoCAD work. It is also time to hop back into the TARDIS and make another leap forward. I'm not exactly sure how far ahead we're going because of those missing dates on my charts. I guess we'll have to wing it and hope for the best. Okay, let's have a look around. Yes, it seems we are right on target, although oddly I don't see a calendar lying around. I do, however, see another spreadsheet (Figure 5) created a number of jobs later.

As you can see, I've continued to make progress on my quest. Previously, I stated "Until you know where you are currently, it will be difficult to establish goals for where you want to be." I'm going to show you one more spreadsheet. Actually it is a scan of some charts I had made at the time. You see, I had neglected to close the file on my computer when I needed to make a slight time jump. I was not aware that Doctor Who's nemesis Henry van Statten was nearby. Upon my return, the spreadsheet was missing and I was left with only printouts I had made on my dot-matrix (see Figure 6). There's no telling what old Henry has in mind for those charts and he's probably the guy responsible for the missing calendar, too.

I've added some coloration so you can match the charts up, but there is a little more explanation to do. First, the vertical bars represent the trend of the particular metric measured over the accumulated individual jobs—the running average. Second, the upper left graph does not reflect the inclusion of commercial items—this was consistent across the AutoCAD data. Finally, the lower left



chart does separate the model time from the layout time, unlike the previous two charts. For this graph, I plotted the static average indicator from actual data.

The red lines overlaid on these charts are averages taken from the AutoCAD benchmark spreadsheet and the AutoCAD comparison spreadsheet. What has remained unspoken until now was that after first establishing the original AutoCAD benchmark, the goal I had set for myself was to halve my times. At this point I was very close and that was when I set new benchmarks. The shorter red bars to the right were new goals based on the new benchmarks. You'll notice they were not as aggressive as the first goal. I felt there was a law of diminishing returns that would enter the picture; however, I underestimated the continued gains that were possible. Relentless pursuit would shatter those marks.

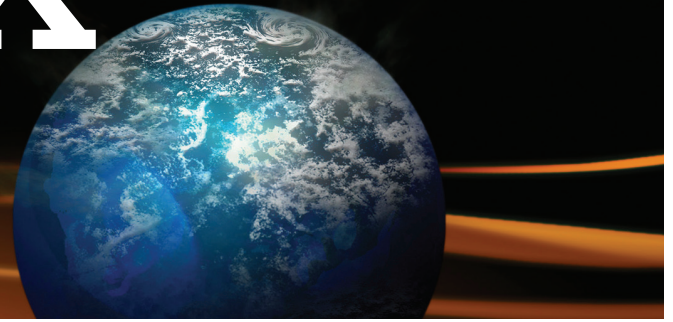
Well, the alarm on the TARDIS is ringing like mad. Doctor Who must be having some type of emergency and desperately needs his vehicle back. We must return to the present so he can take care of his business. Ah yes, here we are, all back in one piece and it looks as though the TARDIS has retained plenty of power. The Doctor will be pleased.

To conclude these little time travels, I hope I've given you some insight to arm yourself for your own time traveling. There is much to be gained with a little effort, and resources are available to aid you in that quest. As you begin your travels, perhaps our paths will cross and we can share a beer in some corner of the Fitzroy Tavern.



Patrick Hughes is a machine designer in Rockford, Illinois, USA, and owner of Engineered Design Solutions, a provider of machine design contracting services. He has developed numerous AutoLISP and other software solutions to automate his workflow and increase his productivity throughout his years in business. Patrick developed the CadTempo time tracking program to aid his quest for further refinement of his processes, and invites you to investigate how it may help your organization. Find out more by visiting the EDS website at [www.cadtempo.com](http://www.cadtempo.com).

# World, Meet REFLEX



## WHO?

You know, REFLEX Render, the latest design collaboration tool. The name and interface are simple, its effort is complex, and its results are absolutely amazing! REFLEX is developed and delivered by Advanced AEC Solutions, LLC (aAECs) out of Atlanta, Georgia, USA, and can be found at [www.aaec.com](http://www.aaec.com).

## WHAT IS IT?

REFLEX Render is a flexible photorealistic rendering solution for designers, architects, engineers, construction managers, and property lease managers who must coordinate and convey the exterior and interior design of a building project with owners, designers, and construction team members.



## HOW DO YOU USE IT?

REFLEX serves its clients as a digital design visualization tool to work within the Autodesk® Revit® platform of design tools. It does this preferably on a second monitor at your workstation. You're working with Revit on one monitor and a REFLEX viewer opens on the second monitor. This allows you to develop your Revit model and see the results of a design change in the REFLEX viewer at the same time. Wow! This can save so much time from our design workflows.

You know that really cool Revit model you've been working on? REFLEX displays it exactly as you have modeled in Revit. Exactly! REFLEX will visualize your modeled objects exactly as they would appear with every natural and artificial lighting effect taken into consideration. This would also include light reflections, refractions, surface textures, opaque, translucent, transparent, and shadow conditions on and around every object. If I model a pool

of water and placed a person in the pool, I would see the body's refraction in the water. That, and the person's body and clothing color depth and visual magnification change as well.

Considering how much this software does, you would think it would use a lot of computer resources, but it doesn't! This software is considered a cloud-based system, meaning that it delivers computing as a service over the web rather than as a product installed on your computer. So, shared resources, software, and information are provided to your computer and other handheld devices like a utility over a grid, much like your office power is delivered over the power company's electric grid.

REFLEX is delivered directly over the Internet in the same way. To use REFLEX, download and install a plug-in from the web. Once it is installed, you will need to upload your model to the aAECs' Cloud, and magically your model beams into your REFLEX viewer illustrating all your model has to offer, including geometry, materials, and lighting. Beyond this 40MB plug-in, the rest of this very powerful program resides on the aAECs' servers. After a simple install of this REFLEX rendering plug-in, Revit is equipped to illustrate your design photorealistically, and so fast that you'll be able to do multiple renderings in the time it used to take you to do one, and you'll do it regardless of whether the images were exterior, interior, day, or night. Really!

## OK, BUT WHAT CAN I VIEW?

You can view whatever you wish as long as it relates to your modeled geometry. Using Revit's camera views and a lit up area within your Revit model, you can view any modeled geometry.



Are you wondering if you'll be limited to where you can go within your model? You know, like a lot of visualization software, you would have to create a path first. Well, there's no path, and no worries, mate! If you can create a camera view of a lit up area that interests you, you will see the image converge in the REFLEX viewer. What's converge? As the model begins to materialize in the REFLEX viewer, the image begins with a fair amount of graininess. Within seconds, this graininess is reduced dramatically, and as time goes by, the image detail clears further to create a very sharp rendering. The amount of time it takes to clear up can vary greatly depending on the geometry, materials, complexity, and the lighting within the model. On average, you will see your modeled geometry within a minute of it converging in the REFLEX viewer, and a very crisp rendering within an hour.



For those of you accustomed to renderings that take 20 minutes just to show if the lights are on in the scene, you'll find REFLEX a vast improvement. You can put a special modeled light fixture in your Revit model, pull it up in the REFLEX viewer to check its light source, change the light value in Revit, pull it up again, all in a matter of minutes, not hours. Of course, you'd probably change multiple light fixtures at the same time to optimize your time. But you wouldn't have to.

## WHAT ABOUT ALL THE RENDERING SETUP TIME?

What setup time? Beyond creating your usual modeled systems and components such as walls, floors, ceilings, doors, windows, lighting, furniture, and casework, upload your Revit model to aAECs' REFLEX, and don't sit back! The REFLEX viewer will display your modeled visualization so fast you won't have time to go for coffee. Sorry!

Though upload times may vary based on your Internet service upload speed, REFLEX realistically illustrates interior and exterior scenes photorealistically without the heavy setup time. So, you won't have to recreate your renderings time after time, with those times being hours upon hours, just to find the image still needs tweaking. Long gone is the notion "just set it up and let it run through the night." The technology behind REFLEX eliminates the traditionally long wait of rendering time. It turns hours into minutes.

Standard 3D rendering techniques often require expensive computer hardware, extensive setup time, and lots of technical guesswork to produce and perfect virtual 3D scenes. REFLEX allows even novice Revit designers to dynamically interact with highly complex 3D data in a manner that is not reliant on the user's own in-house hardware and software capabilities.

## WHAT ELSE CAN YOU DO WITH IT?

The possibilities are staggering, but to the point, collaborate! Turn on your imagination for a moment—now imagine you are a lead designer for an average-sized architectural firm. You have created a very cool design using REFLEX to visualize a major project and need to: first, get a sign-off of the design by your client; second, illustrate the design to your engineers and production team; and third, convey to the general contractor and the associated trades what is needed for construction and fabrication.

Sometimes, the people involved are pretty good at understanding simple 2D plans and elevations; other times, not so much! So, to save a whole lot of time, you have a meeting (or two or three), to illustrate the design using REFLEX Render. Before each interested party, you manipulate your Revit camera views to display your model photorealistically until everyone has seen and understands all aspects of your design. When you're finished, you not only have a bunch of saved renderings for marketing and future design awards, you also have the respect of the entire project team for a job well done.

This article comes to you through the collaborative efforts of:



*Scott A Ebert is the Revit API CM for AUGI, AUGI BOD, AEC/O Industry Analyst, and CEO of Advanced AEC Solutions, LLC, in Atlanta, GA, and can be reached at [sebert@aaecs.com](mailto:sebert@aaecs.com) & [www.linkedin.com/in/scottaebert](http://www.linkedin.com/in/scottaebert)*


and



*Bonnie K Gorman is the Executive Vice President of Business and Product Development at Advanced AEC Solutions, LLC in Atlanta, GA, and can be reached at [bgorman@aaecs.com](mailto:bgorman@aaecs.com).*

# One-Sided Collaboration



 We all like to think collaboration is currently possible. But is it a reality? Most collaboration is still one-sided, meaning that one party does work, then ships the data to another party to use. We call this collaboration; I call it one-sided collaboration.

Technology hasn't yet provided us the means to have an instantaneous feedback loop. When the architect moves an exterior wall five feet towards the parking lot, the civil engineer still needs to do an extensive amount of work to reflect the change in the site work. The architect doesn't have instant feedback telling him that he has run out of property and needs to move back in the wall three feet to make the building fit the site. Is everything done quicker than it was in the past? Definitely, but we still are working in a vacuum, on our own.

One example of this one-sided collaboration is the current utilization of geographic information systems (GIS). Today, the collection, storage, and distribution of data are fairly painless and cheap. Gone are the days where the main choke point of getting the data was the size of the data—whether that be the reams of paper needed or the number of floppy disks required.

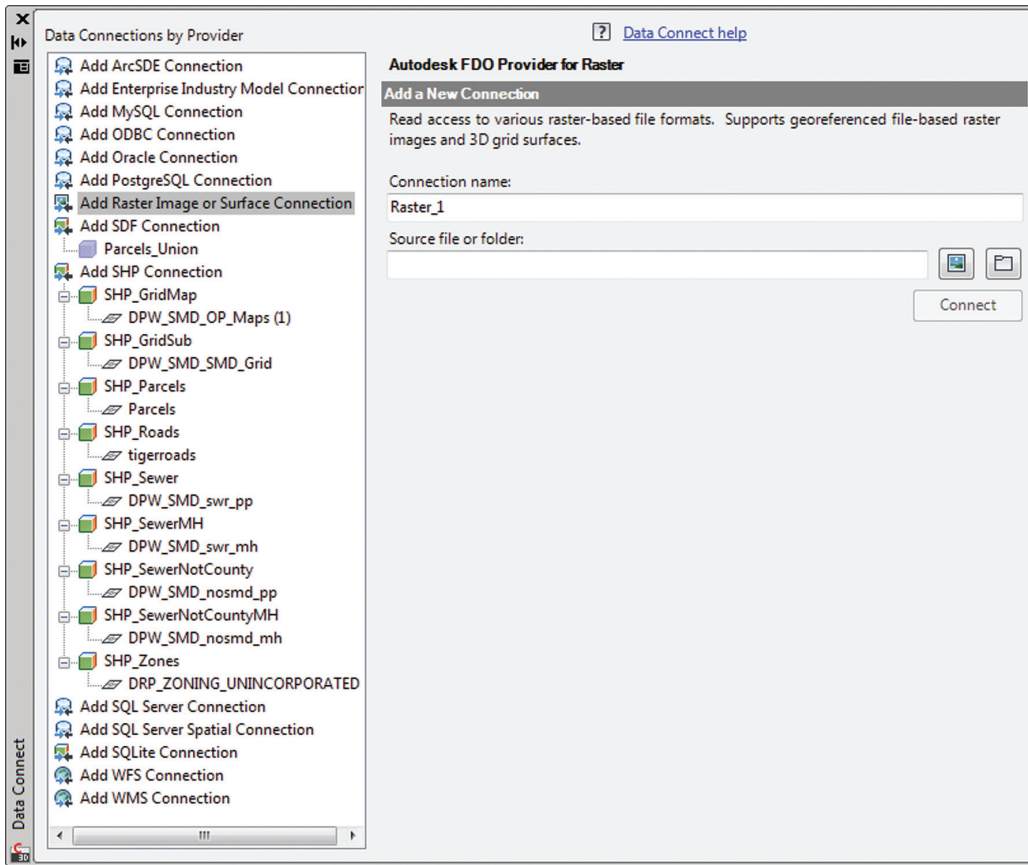
Numerous agencies have taken the opportunity to use this technological benefit to provide GIS data to the public at little or no cost. Unfortunately, other agencies put up large pay walls, making getting the information both expensive and difficult to obtain on short notice.

In southern California, Los Angeles County and Orange County provide an example of this stark difference. Los Angeles County provides the information free of charge, or, in the case of parcel data, there is a small charge for the CD. Orange County, on the other hand, has third-party providers funneling the data to the requesters of the data at quite a large penalty cost.

This available data provides one-sided collaboration. The agency provides the data and it gets consumed by the public. For the most part, consumers of the data outside the agency have little or no input on the content of the data being produced. If not well-documented, one must prospect the data, looking for the "gold" needed to get the task in question done. Once collected, the data may be utilized in the GIS program of choice. My product of choice is AutoCAD® Map 3D 2013 (Map 3D).

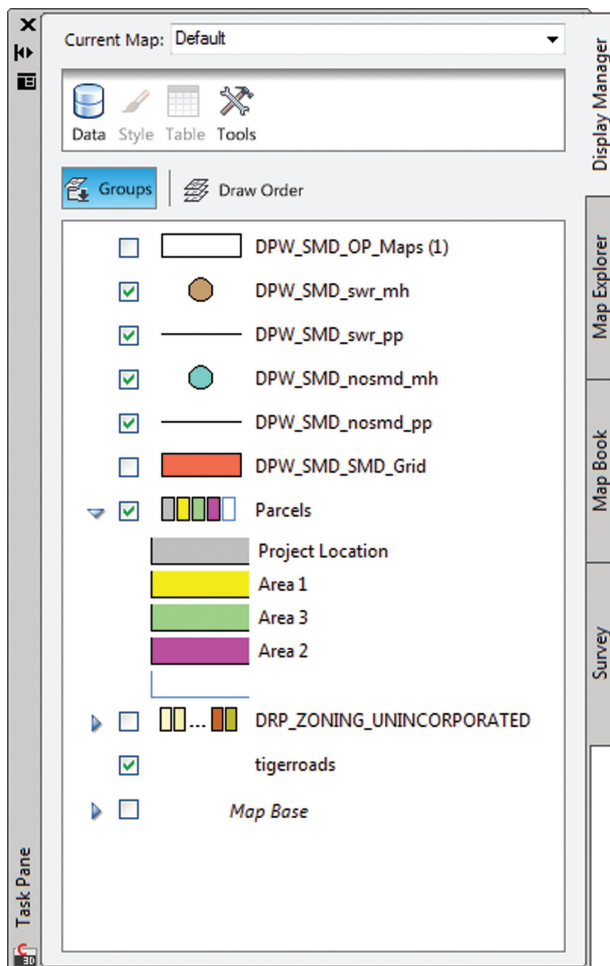
Like most Autodesk products, Map 3D provides a plethora of ways to process GIS data. Data may be imported by inserting the information with object data as AutoCAD objects. The more complex option is the importation of data using Autodesk Feature Data Objects (FDO). Both options have their plusses and minuses. If you are more comfortable with AutoCAD objects, then you will probably be more comfortable with the first option. The object data is conveyed utilizing annotation templates, which are blocks with extended functionality. The annotation blocks are then easily moved and adjusted to convey the required information to the consumers of the created exhibits.





FDO, on the other hand, utilizes dynamic styling, which is a combination of how the data looks in the form of objects and labels to convey the information. This takes a level of knowledge to create queries of the data, which may be a struggle for most individuals if they don't have training. Building labels can be difficult—the process is almost like programming to construct labels.

As you zoom and pan through the drawing, the labels move and adjust to show correctly. When interacting with the drawing, this can be a great attribute. Unfortunately, if you are creating outputs to maps or exhibits, this can present problems. The inability to pin the location of the labels can become problematic when trying to prevent overlapping labels. It is possible to export the labels to AutoCAD, but unfortunately, this prevents the dynamic nature of the labels.



Another benefit of the FDO is the ability to set up a map for the analysis, which can be used on other projects. For large county data, you most likely only want to query a small area for a study. Map 3D provides the ability to come back in and change the location query. This makes it easy to reuse the styles and map styles already created. This may be done by going into the Data Connect palette and modifying the queries for the data sources and seeing the map data update to the new location. I've found this feature especially helpful in the past. I guess I could say I was collaborating with myself on projects.

With the data stylized, it is possible to convey the information back to the agency. One way I do it is through sanitary sewer studies. By consuming the GIS data, the information may be processed to demonstrate the expected flow through the existing system and the adequacy of the system to handle the flow from the proposed development. By using parcel data combined with land planning information, it is possible to determine the estimated amount of waste generated from the occupants or processes of the occupants. By using the sewer line data, the existing sizes and material types may be determined. This provides the factors needed to determine the capacity of the system. The collaboration is then passed back to the agency for concurrence on the findings. While the agency may have provided the data, the collaboration is one-sided in the sense that the analysis of the data is what they get in return. The agency doesn't get my GIS map, but gets a paper copy or a PDF.

A significant downside I found when using Map 3D for the analysis is the inability of the product to provide summary quantities of the data. I created a nice map with a legend indicating what all of the colors meant. Unfortunately, there isn't an easy way to collect



the linear distance of sewer network being analyzed or the parcels broken up by land use and area.

I was disappointed to realize that to get the data, I need to destroy the dynamic map styling to grab the data from the resulting hatches. Thankfully, my study area was relatively small with nearly homogeneous land zoning. It would be nice if Autodesk collaborated with its users to provide a solution to this impediment.

The workflow is useful, and does provide a benefit to both parties. I often stop to think of how the process could be improved. For sanitary sewer systems, it would be nice if the data were easier to analyze. I spent a few hours trying to figure out which areas ended up flowing to the point of connection for the development I was working on. Using a combination of GIS data and as-built plans, I think I got the flow areas correct. The challenge may have been caused by the person between the chair and the keyboard not knowing how to use Map 3D to do the analysis, the lack of sufficient pipe information to do such an analysis, or the specification writers of Map 3D for not creating the feature.

Map creation feedback would also be useful. If the agency could review the map during the report creation, it would help save time—especially if you assumed a flow was going in the wrong direction or if the sewer system in the field had changed. This would provide for closer collaboration between the stakeholders of the project.

For the engineer it would mean less time redoing work due to incorrect assumptions. The agency would benefit by being assured the analysis was done correctly.

If you aren't participating in this one-sided collaboration, hopefully you will see the benefits and embark on the journey. I found it worthwhile to take the time to understand how to use the tools in Map 3D to do sewer studies for proposed developments. It was an improvement over using assessor's maps and as-built plans to determine the areas and flow direction of the sewer lines.

I hope the process is improved in the future, and until then, I plan to continue to utilize the tool when the opportunity presents itself.



*Christopher Fugitt, PE, is a Civil Engineer and has spent the last eight years designing government projects as well as residential subdivisions. He now provides Civil Engineering and Civil 3D services at Civil Reminders. Christopher maintains and authors the Civil 3D Reminders blog at <http://blog.Civil3DReminders.com/>*



# Flexible Scheduling

When it comes to pulling everything together in Autodesk® Revit® MEP, the scheduling tool is a natural fit to display a large amount of data in a compact package.

Schedules are unique in their ability to convey not only a large quantity of data, but also diverse information from many disciplines that can include the ability to total, assign costs, and calculate. This makes schedules the ideal tool to collaborate between architectural, electrical, and mechanical disciplines and ensure coordination. This article will demonstrate the basics of Revit schedules and show some nifty strategies to leverage the Revit database to collaborate with the entire team.

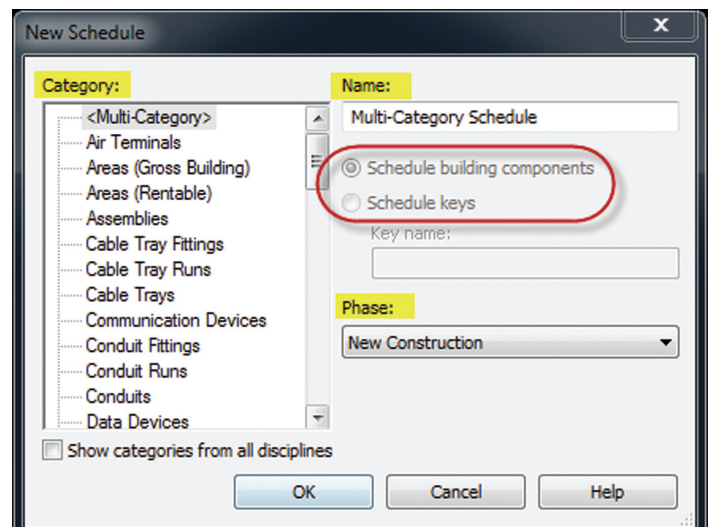
The Schedule tool is found on the View tab of the ribbon and includes five types of schedules: Schedule/Quantities, Material Takeoff, Sheet List, Note Block, and View List. The Schedule/Quantities type produces a schedule of a selected family category. Most of schedules are of this type. To create a new schedule, select the Schedules/Quantities tool. This opens the New Schedule dialog box.

All Revit entities are categorized. Select the appropriate family category to schedule by selecting it from the drop-down list. Only one category can be selected at a time. <Multi-Category> can be used to apply all categories at once. Typically, filtering is used with <Multi-Category> to narrow the schedule to the desired categories. The Name of the schedule will automatically fill out once the category is selected. The name can be accepted as is or cleared and typed in as desired.

Under the name, users have the choice of creating a schedule of building components or creating schedule keys for every category except <Multi-Category>. Scheduling by building components searches the Revit database for a specifically categorized family and accesses its parameters. Schedule keys can be used to apply information to multiple items that have the same characteristics. If an electrical device, mechanical equipment, or telecom device has a defined key and is added to a schedule, fields in the schedule will automatically update with the keyed information, reduc-

ing the time required to produce the schedule. Schedule keys are instance parameters and project parameters, which automatically apply themselves to every family of a particular category. Values applied to the key are applied to the individual elements. For basic schedules, just select “Schedule building components.”

Schedules are phase aware. Use the Phase drop-down to select the phase of the current project from which to schedule components. This way, existing elements can be filtered out of a schedule of new equipment, or a schedule of existing lights to be relamped can be created.



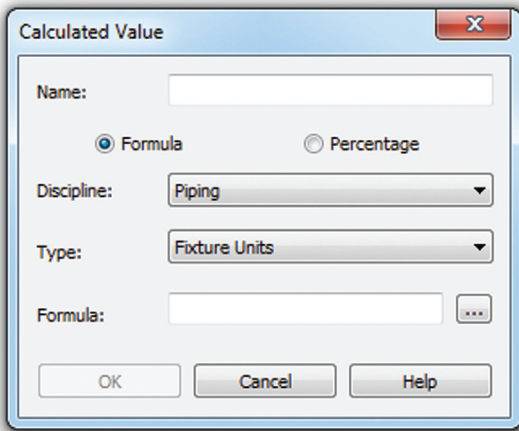
Select “OK” to open the Schedule Properties dialog. The first tab in this dialog is the Fields tab. Different parameters for the selected category are listed in the Available fields: window on the left. Use the Add-> button in the middle of the dialog to add selected parameters to the right-hand side Scheduled fields window. The <-Remove button can be used to send parameters back to the left window. If a required parameter is not available in the left window, the Add Parameter can be used to select/create a project or shared parameter. Depending on where the families in a project come from, the use of project parameters can come in handy here.

In the case of lighting fixtures, a set of standard light fixtures is often created and added to a company-standard Revit template with

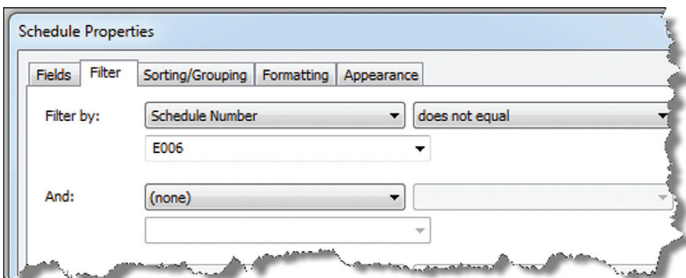
# Revit MEP 2013

all required parameters for scheduling. When a specialty fixture is downloaded or acquired from the architect, that family will have to be edited to add the required parameters. To avoid editing or missing these specialty families, a project parameter can be added to the template. The project parameter will attach itself to every family categorized as a light fixture, no matter where it came from.

The Calculated Value button can be used to add percentages and formula-driven data to the schedule. Give the field a name, select formula or percentage, and then pick the discipline of the field. This is used to apply the proper units to the field. When entering formulas, remember that parameters are case-sensitive. This option is especially important in the MEP world because so many things can be calculated directly in a schedule. Again, it is important that the parameters exist in the families that are being scheduled in order for calculated values to work. Some great examples of calculated values are watts per square foot, CFM per person, and cost per square foot.

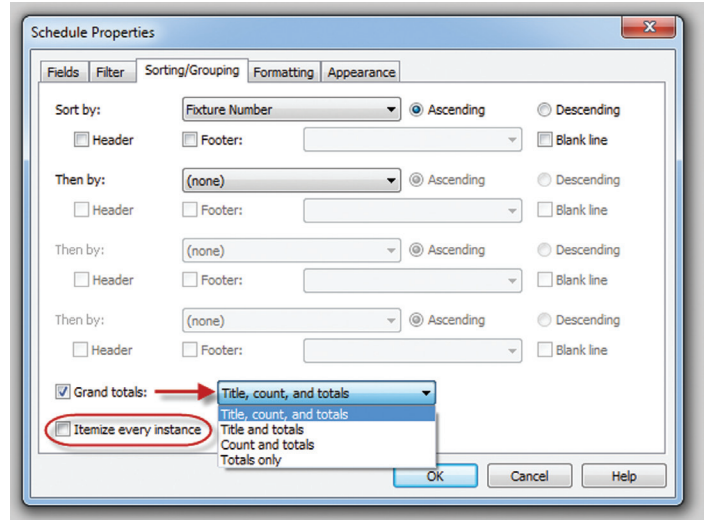


The Filter tab allows a category to be filtered by the parameters of that category. A common application here is the use of a schedule number parameter to associate families of the same category to differing schedules. In this way, types of mechanical equipment such as terminal units, pumps, and air handling units can have their own schedules without having to weed them out of a mechanical equipment schedule, which finds every piece of mechanical equipment in the model.



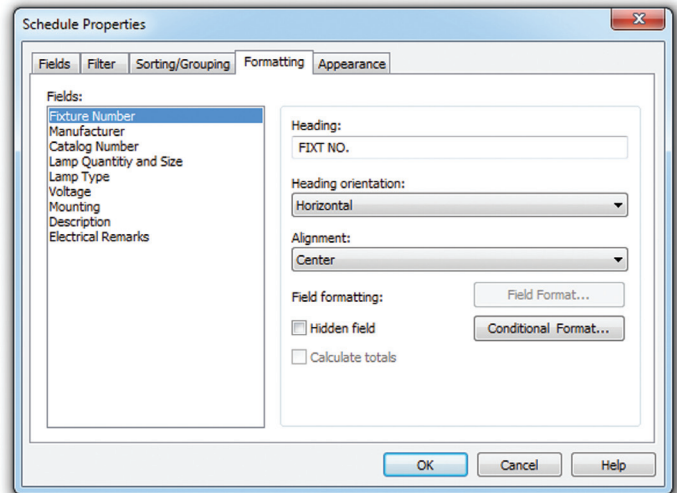
The Sorting and Grouping tab lets the user sort the data in the schedule by parameters either ascending or descending. A header, footer (or both) can be added to each sorted parameter in the finished schedule along with a blank line by checking those boxes.

Below is a check box for Grand totals. If checked, the drop-down to the right gives different combinations of data to associate with the totals.



The “Itemize every instance” check box creates a separate line for every instance of a model element. If left unchecked, similar elements are combined into a single row in the schedule.

The Formatting tab addresses how each field in the schedule will appear. Select a field on the left to control its formatting. The heading of the schedules automatically reflect the name of the field, but can be overridden by typing a new heading in the provided box. The orientation and alignment can also be controlled per field.



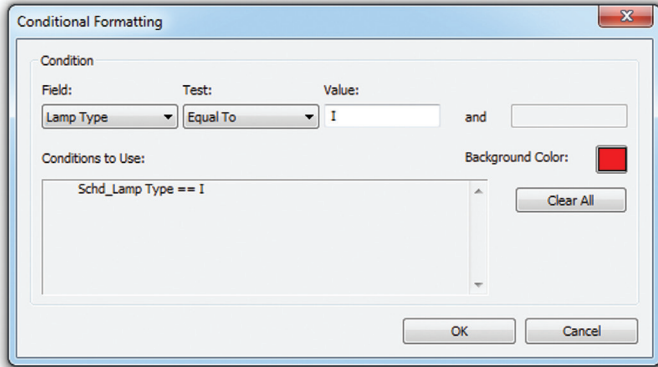
There is a check box to hide the field in the schedule. This enables sorting and filtering by fields that are hidden in the schedule. A cost can be added to a schedule for internal use, and can be hidden when present on sheets for a project. Or an intermediate value used in a calculation can be in the schedule, but hidden to keep things clean.

If Grand Totals is checked in the Sorting/Grouping tab for a field, the “Calculate totals” box is enabled. This will place a grand total at the bottom of the schedule. Where calculations are involved, the

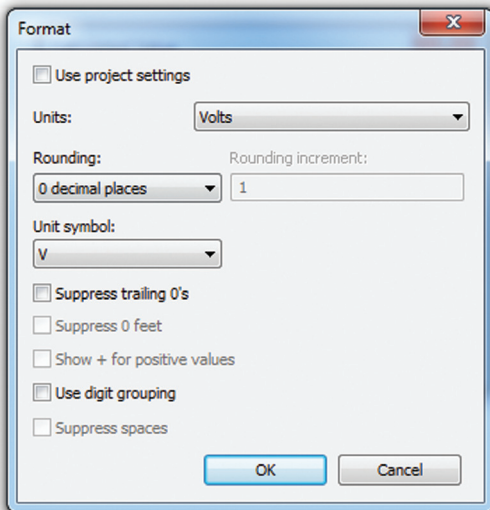


totals option will follow, so it's a good idea to try it a lot of ways to test how it looks in an actual project.

The Conditional Format button can be used to change the background color of a cell based on the value of the data in the cell. This is usually used to alert schedule users that a condition needs attention such as low volume, low light level, or excessive distance. The conditional format option uses logical tests to compare the value in the cell pass or fail to a benchmark value. If a passing condition exists, a background color can be applied to indicate a problem (red) or a pass condition (green).

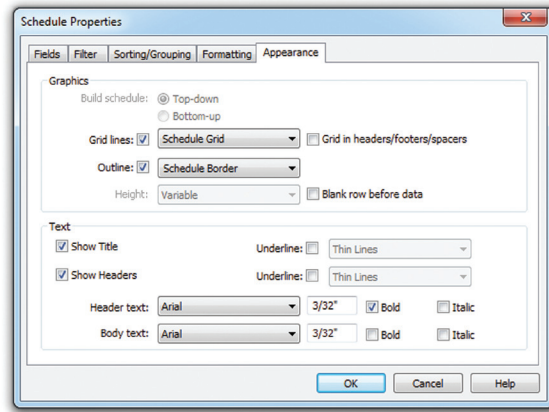


The Field Formatting button is available for numeric fields, and allows for control of numbers' format. By default, the "Use project settings" box is checked. When checked, the settings in Project units are used. When unchecked, these settings can be overridden in the schedule. This is handy to remove the unit symbol, suppress zeros, or change the rounding of a number. This is usually the case when project units are needed for labels, but redundant in a schedule where the unit is indicated its heading.



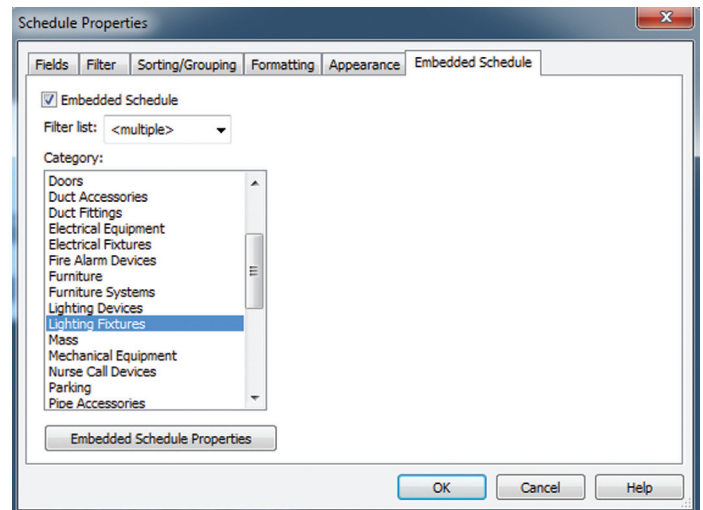
The last tab, Appearance, controls the title, headers, fonts, and linework of the schedule. It's not a bad idea to create standard line styles for the grid and border lines and select header and body fonts according to company standards.

A bonus of using Revit MEP compared to other "flavors" is its ability to nest schedules. This allows for a schedule of rooms that



will report what MEP objects are inside of these rooms by nesting a MEP schedule inside of a room schedule. Select the Embedded Schedule tab, then check the Embedded Schedule check box. Select the category of family to add, and then pick the Embedded Schedule Properties button to format the nested schedule. This starts the process of formatting all over again for the nested schedule.

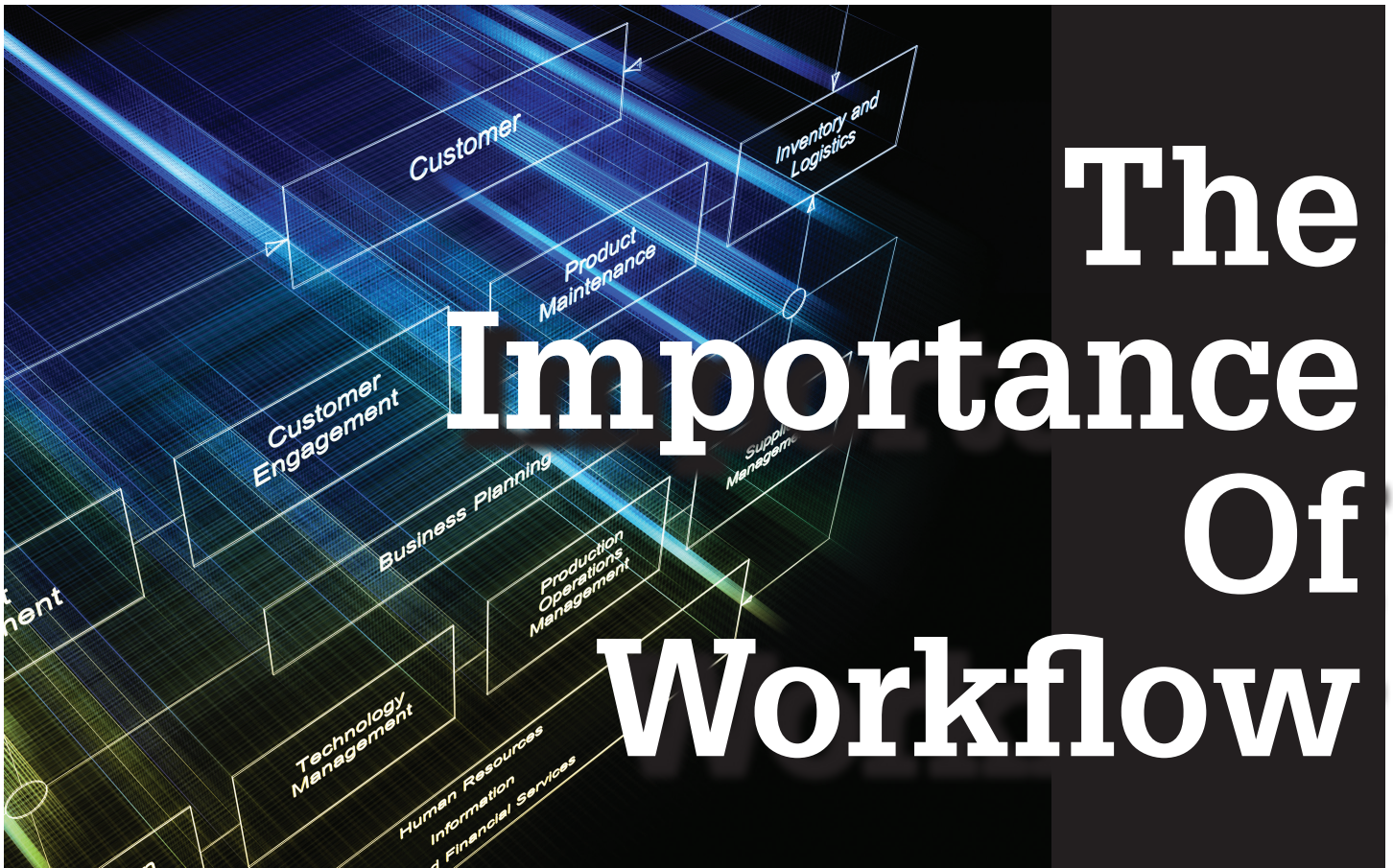
This can get dizzying when first attempted, but reaps huge benefits for those who master it.



As with any Revit MEP tool, experimentation is required. With so many options and configurations, the combination of results is vast. Chances are, whatever the task, it can be done with a little perseverance and the willingness to fail before succeeding.



*Carla Edwards is a BIM/CAD Manager for Leo A Daly in Omaha, Nebraska, and the President of the Revit User Group of Nebraska. Look for her to present at the Central States Revit Workshop 2012 in September.*



# The Importance Of Workflow

**I**ntegrated Project Delivery (IPD) is a big buzz word in the Building Information Modeling (BIM) world these days. Part of the IPD process is to have a clearly defined workflow so that all parties involved understand the role they play. I like to think of workflow as an instruction manual.

The best time to define the workflow is as early on in the design process as possible. I can say from experience that most companies do not lack the ability to develop a workflow in terms of “how-to” documents and the like. However, most companies fall short when it comes to implementing their brilliant ideas, because the accountability factor has been overlooked.

All the steps in a defined workflow need an individual or department to be held accountable for its execution. Although this article will focus on collaboration for integrated project delivery, the same methods can be applied to anything that requires a workflow.

## WORKFLOW EXAMPLE

What types of workflows can be defined for how a structural engineering firm would manage its Autodesk® Revit® model? It is essential to understanding the end deliverable and scope of work in order to make the right decisions when laying out your workflow. For example, if you know it will be a large project and will require phasing for material delivery to the job site, you will make different choices than you would for a small project. Following is a sample workflow chart that will help address the issues of a project that needs to include phasing.

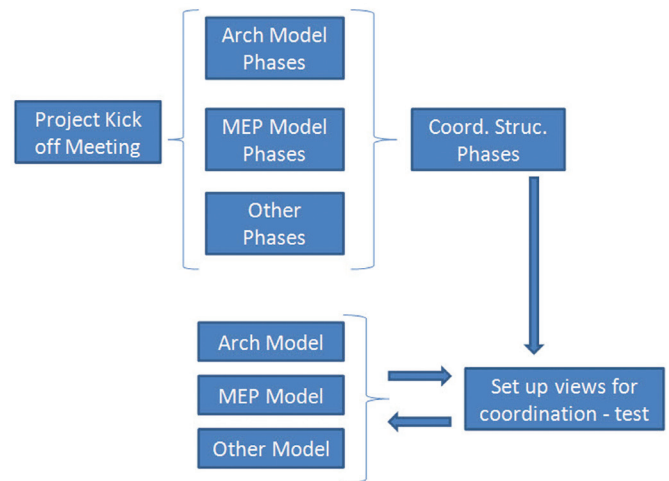


Figure 1: Basic workflow for adding phases to a Revit Structure model.

Once the above workflow is agreed on, you must assign accountability for each step in the workflow to ensure the phases get applied to the project early on. With a workflow strategy, you can save hours by applying phasing early rather than waiting until a later date.

The enhanced workflow diagram below does a better job of conveying the workflow process. The project team can have an improved comfort level knowing that someone is responsible during each step of the defined workflow.



model that is clean and has the level of detail I desire. As long as it is communicated up front, the architect has no problem setting up that view for our use. Below are the steps and dialog boxes involved.

Step One: Go into your visibility graphics and select “By Host View” in the Revit Links tab to change the setting to custom.

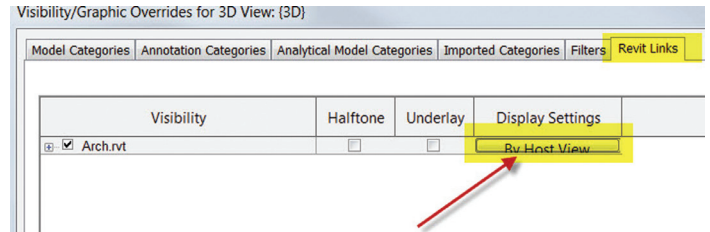


Figure 4: Visibility Graphics, display settings.

Once you select “By Host View” you can change the linked file to “Custom,” which allows you to specify the view in the Architectural model you would like to reference.

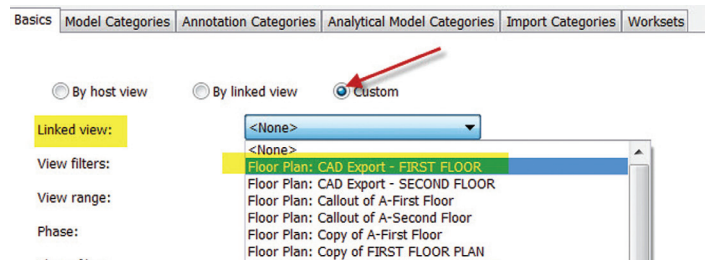


Figure 5: Linking custom display settings.

Though this may seem trivial, it is a big time saver when coordinating construction models between disciplines.

## SUMMARY

Hopefully, with these examples, you can begin to implement workflow on your projects. I think it is true that “a picture is worth a thousand words.” A basic workflow diagram communicates to the IPD team three major points.

1. How the project should progress through different stages.
2. Who is held accountable for each step.
3. Where supporting documents are located.



Philip Russo began with AutoCAD version 2.5 in 1986. Through the years, he has held positions in the CAD industry as CAD Draftsman, CAD Manager, Sr. Applications Engineer, and Certified Autodesk Instructor. Lately Phil's focus has been on the implementation of standard practices for the Revit product line. He currently holds the position of Sr. Technical Application analyst at O'Brien & Gere Limited. O'Brien & Gere is an engineering firm located in Syracuse, New York. Phil can be reached at phil.russo@obg.com

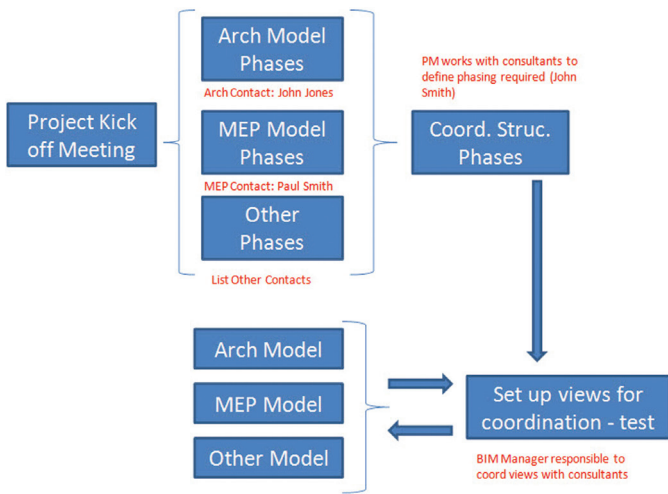


Figure 2: Assigning accountability.

Sometimes it is necessary to refer to supporting documentation in order to take this workflow to the next level. In this case, the office may have a standard document for naming phases in your Revit project.

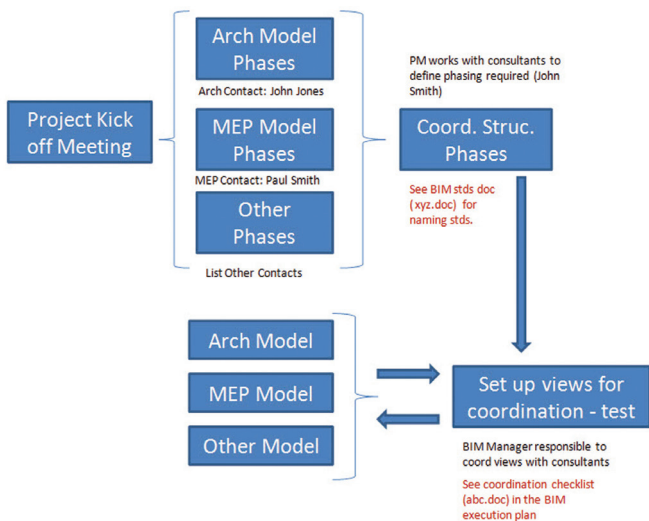


Figure 3: Completed workflow diagram.


## MODEL SHARING TIP

The main purpose of IPD is that all stakeholders are involved as early on in the design process as possible. At these early meetings, it is essential that each discipline communicate its needs for linking other consultants' models.

Workflow is a concept that requires documentation and will help eliminate communication issues that typically happen during the life cycle of a project. Most projects involve more than one model or drawing file. These files are referenced by other consultants, which creates the need for coordination views and reference views. Structural and MEP engineering firms need a clean architectural background to reference in their construction documents to ensure proper coordination.

From a structural point of view, it is a big time saver if I can adjust the visibility graphics to look at a predefined view in the architect's

# Better BIM Collaboration

 **W**ant to get the most collaboration out of your BIM Team? These recommendations, based on many years in the BIM trenches, will help your BIM coordination efforts run more smoothly.

## GETTING THE MODELS THE WAY YOU NEED THEM

Have each discipline that uses Revit create a specific 3D view called “3D BIM Coordination” using the “Duplicate View” command. Hide all elements that have no relevance to 3D model coordination (movable furniture layouts, grid lines, and so on). This will assist in keeping the file sizes as small as possible and make the models less confusing. Make sure all section boxes in the “3D BIM Coordination” view are hidden. This view, once set up properly, will contain the correct visibility settings you wish to export and will be always set up for future model version updates.

If a discipline does not have the appropriate 3D object that represents a specific component of their model, have them use a 3D “placeholder” shape in the form of a cylinder, sphere, cube, or rectangular object to indicate your element, making sure it is the same general shape and physical size as the actual object. This placeholder can be replaced later by the specific component or element.

## WHAT'S IN A NAME: ESTABLISHING ELEMENT NAMING GUIDELINES

Each discipline should be requested to name model elements and components based on a logical system agreed upon by the BIM

Team. A BIM project is a 3D data base from which meaningful information is to be extracted and sorted.

Get a sample list of element family naming conventions from all disciplines to be used to compile a master Element Naming Guidelines document for the team. Whatever naming convention is chosen, it should be descriptive, logical, structured, and consistent. Create unique short names, using natural language that describes how the object is identified in the real world and include the general class of object or the family category as the first part of the file name. When you mouse over an object in Autodesk® Navisworks with “Quick Properties” turned on, you should be able to know precisely what the object is in the Item Name tag that pops up.

## DON'T FORGET

Maintenance or Serviceability Zones consist of clear space necessary for maintenance and repair access in front of electrical or equipment panels, ceiling access panels with clear space above and free space below, or access to valves. Indicate equipment (pumps, valves, VAV boxes, etc.) accessibility areas with rectangular massing objects that go from the floor to the ceiling or in front of access panels.

“No-fly Zones” consist of spaces above electrical and equipment rooms that need to be clear of trades other than electrical to accommodate the copious conduit runs necessary or space below roof access openings that should be clear of any system elements. Indicate No-fly Zones and Maintenance Zones with semi-transparent rectangular massing objects next to their respective element(s).



“Crop circles” objects indicate approved distances by the structural engineer between locations of anchors attached to decking used to fasten hangers. Crop circles cannot overlap and can be modeled using flat cylinders.

Major equipment with ducting or piping that travel overhead or through walls may need to be modeled (stoves with hoods and exhausts, boilers, overhead cabinet seismic bracing, and the like.). Also, turning radii for wheelchair access can be indicated by red 5’ diameter semi-transparent cylinders.

## DON'T DOUBLE UP

Doubling up on model geometry must be avoided. Have BIM Team members include in their models only the elements checked below for their discipline. Architects and structural engineers will duplicate or use the same model for most of the structure; architects and plumbing disciplines often model their own version of plumbing fixtures. Resolve between disciplines the elements that should be contributed in each discipline’s model in order to eliminate elements that could create duplicate clashes or confusing results.

Create a chart like the one below, indicating all elements to be modeled, and then share it with the Team. The elements listed below are often disputed, but choose only one discipline to contribute these elements for the Consolidated Model.

Model Element Responsibilities Checklist	Discipline								
	Architectural	Structural	Plumbing	Electrical	Mechanical	Fire Protection	Framer	Civil	Landscape
Stairs, concrete									
Stairs, metal									
Fixture locations									
Slab on grade									
Decking slabs									
Topping slabs									
Toilet fixtures									
Bath, tubs, and showers									
Sinks									
Urinals									
King studs									
Backing studs									
Soffit framing									
Overhead cabinet bracing									
Headers									

## OMISSION DETECTION

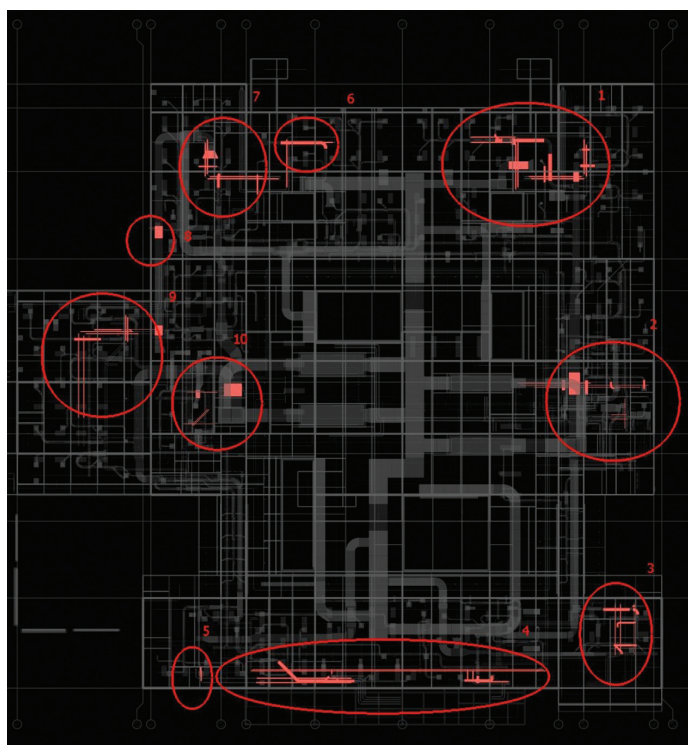
Examine each discipline’s model to look for obvious errors and omitted elements such as “floaters” (floating objects that are too low or high) and “disconnects” (elements such as pipe or duct lines that are not connected), along with making sure drain and waste pipes are sloping. Disciplines should be encouraged to do their own internal clash detection and to coordinate with each other, behind the scenes, so that coordination meetings take less time.

To communicate to the disciplines where floaters and disconnects are located, create a Viewpoint that is zoomed into a floater or disconnect and redline each issue with a circle and place them in a dated folder called “mm\_dd\_yy Floaters and Disconnects” in the Saved Viewpoints window.

## CREATE A KEY PLAN

A clash test “key plan” is the best way to see all issues on a relevant story and is a helpful visual summary for each established test. This top view will reveal the “nests of clashes” that comprise issues needing to be resolved.

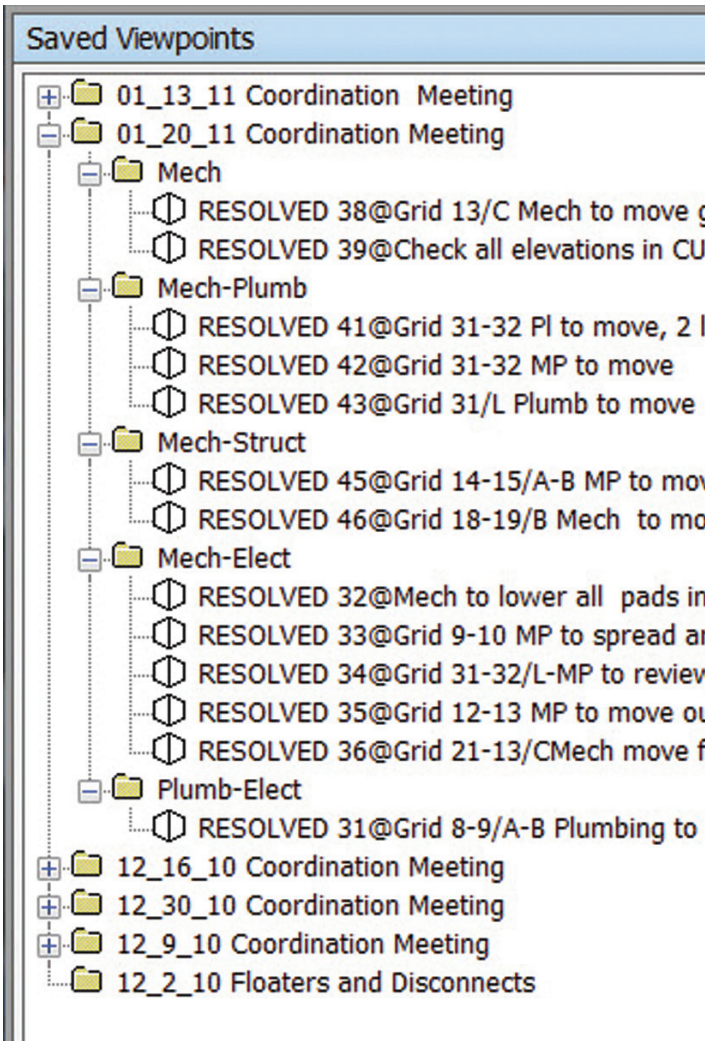
Redline each issue with ovals and name them accordingly with a number along with the grid line closest to the issue: “1 @ A-5”. Export this image as a JPG and save it into the “Clash Reports” folder in the relative week’s Coordination Folder. Continue creating key plans for each established test.



## GROUPING CLASHES INTO ISSUES

Think “issues,” not clashes. Issues are the problem areas we ultimately need to resolve. An issue is often made up of several clashes in close proximity. To discover conflict issues, select an area around a grouping or “nest” of clashes using a rectangular Select Box from the Select/Arrow. This is best done from the top view in the 3D

# Navisworks Manage 2013



Scene View. The “Select Filter” assists in isolating only the clashes that involve the items you’ve selected in the 3D Scene View.

Make this issue a Group and name the Group folder based on the issues identified in the key plans made above and indicate the closest grid lines; for example, “1 @ A-5.”

## ORGANIZED VIEWPOINTS AS INTERACTIVE CLASH REPORTS

Viewpoints are the best way to visually summarize the issues we have isolated in order to communicate to other stakeholders or members of our design team. Consider all the potential reviewers of the BIM Team’s work. Create and redline Viewpoints so that someone who was not a part of the meeting would know what you are trying to communicate.

Create a dated folder for each week in the “Saved Viewpoints” palette (Example: 01-13-12 Coordination Meeting). Within the BIM Coordination folder, create a folder for each test (e.g., Plumb-Elect, Mech-Elect, etc.) Name each Viewpoint the same as the corresponding Group name you gave each issue in Clash Detective, e.g., 1@A-5. Viewpoints redlined and notated can also be reviewed by others using the free Navisworks Freedom viewer or printed out

and distributed to detailers, especially to those who do not have Navisworks Manage.

As an alternative to comments or tags, put abbreviated instructions on what to do as part of the Viewpoint name. The big advantage is that these instructions can then be seen in the Freedom file by anyone reviewing the work of the BIM Team.

When issues get resolved, rename each Viewpoint by placing **RESOLVED** in bold letters in front of each Viewpoint name. This makes it easy to see what issues are resolved and what issues are still open. Each issue that gets resolved is a “mini win” that is OK to shout out in bold.

Maintain a Viewpoint trail. Don’t overwrite the old Viewpoints with every new report. Keep them in their dated folders as a history of the coordination process, allowing the Team and other stakeholders to see at a glance how far you have come. Don’t create clash reports and simply say, “Here you guys go; see you next week.” Assign measurable tasks to make progress and hold all Team members accountable for their results.

## COME FLY WITH ME

Load Navisworks Freedom on all stakeholders’ computers to facilitate having as many eyes as possible flying through on the Consolidated Model. Encourage members of the design team to review the Consolidated Model during design meetings, along with traditional 2D paper drawings. Meet with maintenance staff to show where items to be accessed are, with ceilings transparent and using Search Sets to help in navigation. To make it easier for non-technical people to navigate through the model, create a folder called “Rooms” to store Viewpoints named for each room. Navisworks is good at finding collisions, but cannot find design issues. Only trained professionals can.



*John Stebbins is the Director of Operations for Douglas Pancake Architects in Newport Beach, California. Since 2008, his BIM projects total over \$1.3 billion, specializing in BIM facilitation, BIM execution planning, and 3D BIM constructability modeling. John teaches BIM classes in the University of Southern California’s Construction Management Department and Orange Coast College’s Architecture program. Since 1988, John has been a leader in transitioning the building industry to BIM technology. He has given countless lectures and seminars, as well as led user groups and organized workshops throughout California and Arizona on the subject of virtual design and construction and the power of BIM.*



# Wicked Change Management



**T**his article continues the Wicked Series. The series began in October, 2011 with the Wicked Primer, and was followed by articles on Wicked Problems in Construction, Wicked Tools, Wicked Solutions, and Wicked Procurement. After a break to hear from a couple of guest columnist—Andrew Abernathy and Pete Baston—the series continues.

Change management presents wicked problems in every industry, though the AEC industry seems particularly resistant to change. This article introduces wicked change management in the context of our evolution from a push economy to a pull economy. Next month we will dig deeper into the topic. For now, an introduction.

Emerging knowledge economies depend on Big Data<sup>1</sup> and collaborative analysis of Big Data by integrated teams of collaborators. Building Information Modeling (BIM) a subset of Big Data, provides the AEC industry with a peek behind the Big Data curtain and arms advocates of IPD, BIM, and lean processes with data that mirrors Big Data in other enterprises. Integrated Project Delivery (IPD) and similar collaborative delivery models represent

a beachhead established by advocates of the knowledge economy in the AEC industry. Opponents of change dismiss IPD and, to a lesser degree, BIM and lean business processes for myriad reasons, most of which mirror classic characteristics of wicked problems. Change management problems, whether in the AEC industry or elsewhere, are often wicked problems.

## CHANGE MANAGEMENT (AKA, FIXING STUPID)

The best politically correct definition of change management is “Managing the process and people side of change by planned actions designed to help people to move to a desired outcome.”<sup>2</sup> To state the problem less delicately, change management requires that we fix stupid. Fixing stupid, as your father likely told you, is no small task, but that is the essence of change management.

Professional consultants euphemistically refer to it as a soft science. Research confirms efforts to plan, implement, and manage significant changes within an organization typically fail 70 percent of the time.<sup>3</sup> Thus, the professionals who call it a “soft science” are really saying, “fixing stupid is hard, and if I fail it’s your fault.”

# BUILT

Change management programs often revolve around adoption of new software, new maintenance protocols, and new sales initiatives. In the Built industry, BIM adoption and implementation programs, IPD solutions, and lean processes all involve significant change. The moniker “change management,” a misnomer if there ever was one, ignores the leadership piece of the puzzle critical to adopting and driving change through an organization. Management focuses on tracking productivity and ensuring the team stays on task. Leadership provides the vision, an essential element of any change management program.

Again, fixing stupid is hard. It takes leadership, superior management skills, and a great plan.

## THE EMERGING KNOWLEDGE ECONOMY

As the 20th century’s push economy fails—and flails—the 21st century’s pull economy rises. Some refer to the emerging economy as a knowledge economy, but the term “collaborative pull economy” fits well, too. For evidence of the looming, nay imminent, demise of our push-oriented 20th century economy, see *The Shift Index*.<sup>4</sup> The chart below, excerpted from the Shift Index study, graphically demonstrates the long-term decline in the value of assets held by publicly traded companies in the United States.

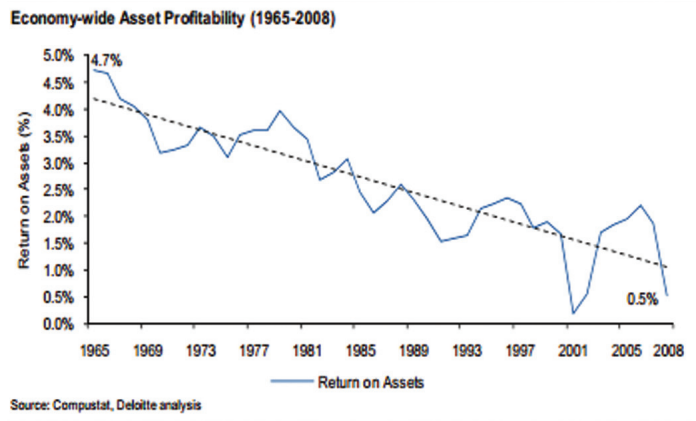


Figure 1: Asset profitability for U.S. firms steadily falls more than 75 percent over the past four decades.

The Shift Index chart above demonstrates that public sector firms lost almost 75 percent of the value of their assets from 1965 through 2008.<sup>5</sup> The pace of loss appears to have accelerated over the past four years for firms that cling to the 20th century push economy model. That decline, emblematic of bigger problems, calls for explanation.

So what explains the death spiral of the old-school push economy and what, if anything, can be done to reverse the trend?

Throughout the 20th century, American business sought to leverage experience and economies of scale in an effort to increase efficiency and productivity. The following image reflects this “experience curve” and the long, slow, flattening of that curve correlates with the decline in ROA reflected in the chart above and dem-

onstrates the classic dilemma of diminishing returns. For a Built industry point of reference, think of design, bid, build as the experience being flattened over time.



By contrast, the 21st century pull economy depends, more and more, on collaboration curves to increase efficiency and productivity. Collaboration, especially on a cross-disciplinary basis, increases knowledge, efficiency, and productivity much more rapidly than sharing stale knowledge about a stale process within an organization. Design, bid, build—contrasted with integrated project delivery (IPD), job order costing (JOC), and even design, build, and construction manager at risk—serves to highlight the value of collaboration.

Integrated team building among multiple firms, collaborative cross disciplinary cooperation among Built professionals within those firms, and joint application of lean business tools and processes increase efficiency and productivity at far greater rates than individual firms can achieve operating alone in their silos. Extensive

**IN THE BUILT INDUSTRY,  
BIM ADOPTION AND  
IMPLEMENTATION  
PROGRAMS, IPD  
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PROCESSES ALL INVOLVE  
SIGNIFICANT CHANGE.**





## Characteristics of a Wicked Problem

**Evolving definitions.** The definition of a wicked problem evolves, triggering solutions which, in turn, change the definition of the problem.

**Continuous solution cycle.** Because the definition of the problem continues to evolve, solutions emerge continuously, concluding when problem solvers run out of time, energy, money, or some other limiting resource.

**Perfect solutions prove elusive.** Objective solutions elude wicked problem solvers, with most ranging from best to worst or acceptable to unacceptable.

**“One off” problems.** No two projects are alike, and thus, no two wicked problems are the same.

**One-shot solutions.** Wicked problems feature one-shot solutions, as every solution impacts the problem and everything the problem touches.

**Creativity and judgment drive solutions.** Pursuit and implementation of wicked solutions depends on the creativity and judgment of the stakeholders.

studies of IPD and BIM demonstrate those tools add value from project to project. With value on a project basis established, the question becomes how to deploy these powerful tools on an industry-wide basis.

## COLLABORATIVE PULL STRATEGIES—LEVERAGING KNOWLEDGE

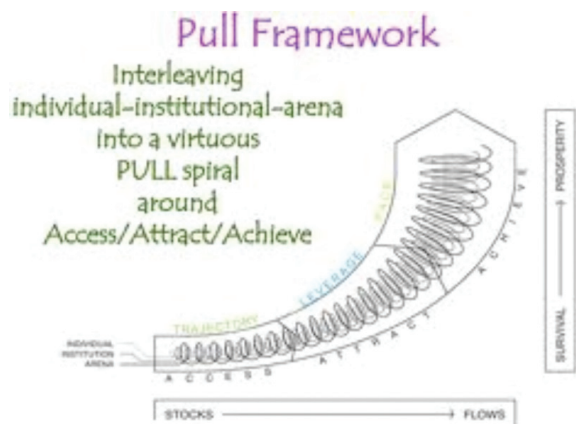
One piece of the puzzle may be 21st century pull strategies. Pull strategies add value through increased collaboration that enables more workers to leverage knowledge more quickly across the economy, providing the Built industry with an exciting path forward.

Access to innovation hubs, attraction of talented individuals and firms to those hubs, and sustained achievement will drive adoption of collaborative pull strategies in the Built industry. The image titled “Pull Framework,” also part of The Shift Index study, provides a graphic representation of these concepts.<sup>6</sup>

Rather than drive efficiency and productivity internally along the axis of an ever-diminishing experience curve, more and more firms look to the ever-increasing returns available to entities that join forces to leverage knowledge over time along the axis of a complex collaboration curve.

BIM user groups, the AGC BIM Forum, the Lean Construction Institute, Stanford’s Center for Integrated Facilities Engineering, the Alberta Center for Excellence in BIM, and Collaborative BIM Advocates, among others, provide forums that attract talented individuals and organizations interested in leveraging IPD, BIM, and lean processes.

Those organizations possess and share vast quantities of information relevant to the task of adopting, implementing, and leveraging those tools in the Built environment, behavior that renders them attractive access points for talented individuals and organizations interested in learning more about those tools. Individual firms also serve as collaborative centers that provide access to critical knowl-



# BIG DATA, BIM, AND ACCELERATING RATES OF CONNECTIVITY ENSURE RAPID CHANGE.



edge. Access points, i.e., those places where knowledge resides, attract talented professionals and entrepreneurs interested in learning more. Achievement quickly follows.

In the Built industry, talented individuals and innovative firms armed with knowledge of how IPD, BIM, and lean processes increase efficiency and productivity at the project level are beginning to extend those processes to broader business models, gaining additional value.

## ADVANCED CHANGE MANAGEMENT TECHNIQUES

Accelerating adoption of a 21st century collaborative, pull-oriented business model ought to be the goal of every AECO industry organization. Big Data, BIM, and accelerating rates of connectivity ensure rapid change. Entities that wish to leverage these innovative tools face a number of challenges. BIM adoption and implementation represents a significant challenge for many in the industry. Adopting the IPD model for projects involves significant and profound changes in both process and culture. Implementation of lean business processes, likewise, requires change. Crafting, negotiating, and executing new-generation legal instruments that support and enable IPD, BIM, and lean processes involves significant change. Organizations interested in leveraging these tools must explore advanced change management techniques that support such radical change.

One such technique involves leveraging brain science. Training change participants to think differently, overnight, by establishing new thought patterns and problem-solving skills isn't the sort of thing most change management professionals claim to do. But one company advocates just such an approach.

Too Serious, Ltd., Toronto, Canada, develops collaborative, hands-on programs designed to change the way participants think about problems. And the two-day program achieves success, literally overnight. A Too Serious distributor in Australia, Onirik, provides a good summary of the program on its website.<sup>7</sup>

Too Serious carefully studies existing business processes for an extended period and carefully models a client's real-world assets, processes, and limitations. Importantly, Too Serious recreates the physical environment in which the workflow normally takes place. Before proceeding, the company brings an array of stakeholders from throughout the organization who tackle change management issues together as a team. Too Serious has used the program to drive change in several sectors of the economy. The program, used successfully in public transportation, mining, and the pharmaceutical industry, takes center stage next month.

## CONCLUSION

Typical construction projects give rise to a series of Wicked Problems, not the least of which is how to manage complex change, especially fundamental changes of the kind IPD, BIM, and lean processes require. Such vexing problems require advance solutions, or Wicked Change Management solutions. Next month we will explore Wicked Change Management in more detail.



*James L. Salmon, Esq. is president of Collaborative Construction Resources, LLC and the creator of the IPD in 3D Program and the BUILT System. James is an attorney, mediator, IPD facilitator, and collaborative consultant who helps stakeholders in the AEC industry implement the BUILT System and negotiate and implement effective integrated agreements. You can reach James at [JamesLSalmon@gmail.com](mailto:JamesLSalmon@gmail.com).*

<sup>1</sup> <http://www.aberdeen.com/Aberdeen-Library/7495/RA-big-data-integration.aspx>

<sup>2</sup> <http://www.onirik.com.au/media/Whitepapers/Cracking%20the%20Change%20Code%20White%20Paper.pdf>

<sup>3</sup> <http://hbr.org/2000/05/cracking-the-code-of-change/ar/1>

<sup>4</sup> The Shift Index Uncovering the Emerging Logic of Deep Change, John Hagel III, John Seely Brown, and Lang Davison, Deloitte Center for the Edge, 2009, <http://www.johnseelybrown.com/shiftindexabstract.pdf>

<sup>5</sup> Id., pg. 11

<sup>6</sup> Id.

<sup>7</sup> <http://www.onirik.com.au/content/what-we-do/brain-reprogramming-emulation-technology>



## SITEOPS RELEASE 6

<http://www.siteops.com/>  
Blueridge Analytics

From the press release:

This release features enhanced design functionality, allowing for more accurate and dependable models and designs. Users can also create, import, and work with Blocks to increase efficiency and reduce redundant tasks. After creating customized SketchUp models—or models from the SketchUp 3D Warehouse—users can import them into SITEOPS via Blocks, create optimized layouts with grading and export the site plans to SketchUp with accurate placement of their 3D models on site plans.

## SKETCHFAB EXPORTER FOR 3DS MAX

<http://blog.sketchfab.com/3ds-max-exporter>

Sketchfab is an app that lets you upload and publish 3D content on the web in an interactive format. Now they have announced an exporter for 3ds Max. Using Maxscript, it lets you export to OBJ, which you upload to Sketchfab. Then you embed the code for it into your HTML document.

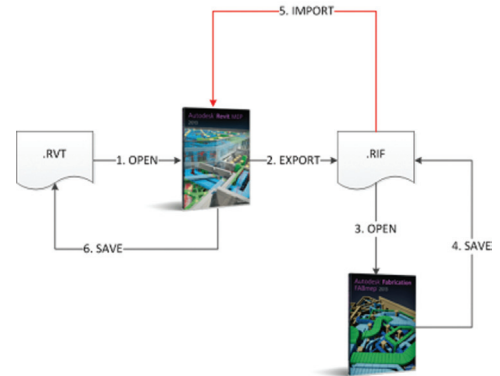


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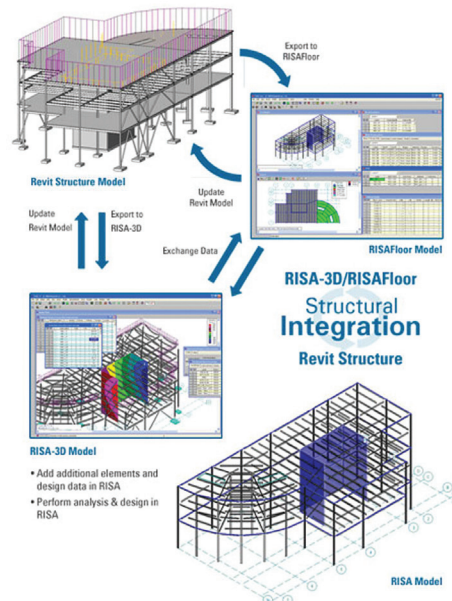
Autodesk Fabrication FABmep provides an export from Revit MEP to FABmep. From FABmep, users can further detail the model, using manufacturer-specific content, and estimate and export to fabrication. The FABmep Import Technology Preview allows users to re-import the final FABmep model back into Revit MEP 2013. One is an export, supporting downstream construction activities; the other is an import for record drawing/model purposes in Revit.



## RISA-REVIT LINK

<http://subscription.autodesk.com>  
RISA Technologies

Coordinate your analysis and BIM models. This two-way link allows you to transfer seamlessly between Autodesk® Revit® Structure, RISAFloor, and RISA-3D.



Until next issue!

If you'd have some news to share with us for future issues, please let us know. Likewise, if you are a user of a featured product or news item and would like to write a review, we want to know.



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