PRESENTER: All right. The key learning objectives for this class. Describe the essential concepts of BIM enabled infrastructure. See advantages of virtual design and construction and other BIM tasks. Know how traditional data sources are converted to BIM model components. Learn how dynamic objects enable the MacLeamey principles. And use InfraWorks 360 as a helper application in your BIM models.

All right, now this is the workflow. I'm not going to go through each one of these, but these are the workflows you're going to see today. Eight of them. And I'm going to be using civil 3D 2016 and InfraWorks 360.

About BIM. We all know that BIM is building information modeling, and it's building in the verb sense, in the creation sense, not in the architectural sense. The key characteristics that I'm going to continue to come back and tell you about as they relate to the workflows that we're going to see, are these four characteristics. It has to be a 3D model, that model has to be dynamic and interact with other systems in that model, it has to be intelligent, it has to have attribution that makes logical sense, and for infrastructure it must be geo-located. We have to know where it lives on Earth.

The possibilities of BIM. BIM is 3D models that can be created from traditional paper documents, or 2D CAD files. Visualization of complex geometry, which is difficult to understand in the 2D world. Combining of 3D pieces to make individual systems, then composing multiple systems into one dynamic model. And finally, showing these systems in real context.

Conceptual simulizations are an important task, whether it be for directing airport traffic during construction, mocking up of a multi-story building, or showing proposed traffic flow in a new interchange design. Many types of simulation and engineering analysis are realized from good BIM models. Such as shown in this complex simulation which shows and includes environmental aspects.

3D modeling often exposes elements that are obscured, such as underground utilities and structural foundations. Clash detection is a BIM task that leverages these elements, and reduces construction mistakes before they are discovered on the job site.

Design proposals are presented individually and in real world context, so that all stakeholders

are equally informed.

Visualization is a great side benefit of a good BIM model, and impressive animations show and tell the whole project's story. This fascinating virtual construction shows how new bridge piers are built, and then how the prefabbed column is tilted into place, and the same construction equipment cranes lift and put the bridge deck on top.

This next video is the ultimate in serious simulation. Watch how the Alaska viaduct in the city of Seattle is compromised in an earthquake, in a major earthquake. We have the lower road deck. As it crumbles and is inundated by the Seattle bay waters, we see the old concrete bridge deck collapse. As the shaking continues it's further compromised, and the concrete structure, the multilevel structure, collapses. Now we also have the structural collapses of the buildings, and then the utilities are compromised with electrical shorts and fires from gas lines.

A key principle in BIM for infrastructure is the real world concept and positioning. And of course we use point clouds to aid in our modeling. The concept of a BIM dashboard is extremely important to monitor these events. And in this case we have the number of airplanes impacted during construction phases. A simple dashboard.

Here's a more interesting dashboard about phases of demolition, temporary construction, new construction, during a planning phase.

This is the ultimate. This is a 5D dashboard. This one has the graphics on the top that is showing me the phases of my construction. I'm going to pause on this for just a minute, because this kind of gives us a whole picture of BIM and how we can use it to justify the ROI and the advantages of the basic concepts of a good BIM project.

Here I have the timeline. These are the tasks. The tasks are simplified here as pre and development tasks, approval stage, and green as the construction phase. Now this is the meter. This is the money meter. Now you can understand that during the preliminary design phase, that money meter is going to run. Then it's going to do what during the approval phase? Is it going to go up or down, as far as speed? What do you think? During the approval phase, how much money am I spending? It's going to go down, correct? Unless we get the lawyers involved.

All right, then think about the money meter when we get to the green phase. What's going to happen to the money meter? Wham.

OK. Now one good sign of a well enabled BIM project, is the fact that the tasks happen in parallel. We don't do one then the other, then the other, then the other. We want to keep the timeline short, because if it's shorter in time, what happens to the money? Hopefully it's less, too. So this is an incredibly interesting graph that shows, and as we saw it run, you could see the meter go faster and slower. And then we could also see that some of the tasks early on are finished, so the money meter is going to slow down. And then the most critical tasks-- this is the actual interchange with fly over design-- is the one that happens last.

So this is a BIM dashboard. This is a 5D BIM dashboard, because I have time. I have the timeline aspect, and then the fifth dimension is the cost aspect. So this is a good picture of a dashboard for BIM for infrastructure.

All right, let's get started. We're going to build a project base map using model builder. Model builder is in InfraWorks 360. Now as I show you these workflows, what I'd like to point out. Remember, I said there were four characteristics of a good BIM for infrastructure. And I'm going to highlight the things that are important about the workflow. In this case, it's going to be Geo-located, and it's going to be intelligent.

So this is the InfraWorks panel. Starting panel. I go to the Model Builder tab, and in the Model Builder, I want to locate my project. And our project scenario today is in Shrewsbury, the United Kingdom. In Shropshire. And it is in this area, here.

So I locate this area. I make sure that my selection is less than 200 square kilometers. And then I make sure that I look at the data sources. I need to know if my data is good, if I trust it. Oh, it's on the internet, so it must be right. Correct? And so it's very important that you just review and understand where this model builder data comes from. Different geographic areas in the world have different precisions. Especially when it comes to the terrain.

OK, now I've had it sent to the Cloud for processing. Lately, it's happening very, very quickly. Within 15 minutes, I get an email that my model is ready. So just a quick review. Make sure that you have a limit of your project that is less than 200 square kilometers. And then also, very important to understand this data comes from Open Street Map. Open Street Map. That means you can go in and put in anything you want, OK? And it would show up in your model. And of course, the satellite imagery comes from Microsoft Bing server. And then the most serious part is the terrain data. You have to really know if it's 30 meter postings, 90 meter postings. In some areas, it's even better than that.

So let's take a look at the model builder results.

Now, here's an interesting concept. In my InfraWorks application, I have signed up and I've subscribed to some of the extra add on features. And model builder comes with regular, I don't need to do anything. Oh, look at this. Open. Open, open. I want to point out to you that once I have the model builder results, I've stored them on my local computer, and I'm not connected to the Cloud. You do not need to be connected to the Cloud to run InfraWorks You can keep it local.

All right, so here is the model that has returned. I'm running it off a SQLite file. It's going to be a big file, it's going to be pretty massive. But let's see what we have here. That's the size of my project.

This is interesting. So in a matter of a few minutes, look at the rich fabric I have. I have aerial imagery, I have a digital terrain model, I have the names of 3D buildings, I have the names of the roads. Now, let's zoom into the area of our scenario. Our project scenario today. We're going to look at a very simplistic development of this land around the sewerage treatment plant, and the hook in the river Severn.

So I am going to export my area of interest using an IMX file. An IMX file is going to bring me all of that valuable information that I need to put into civil 3D. I'm going to use a bounding box. I select the region, because I don't want to take in all of these road center lines. I just want what's in the area of interest.

Make sure you know where you put it on your computer, and we're exporting it to an IMX.

All right. Who's done model builder here? OK, more than half the people have done model builder. It's fantastic, please try it.

Now, about InfraWorks 360. What it can do. InfraWorks 360 is an amazing tool. And one of the huge advantages of InfraWorks is that it gives you this real world context instantly. Now it works in latitude and longitude, but it can also, when we bring this information out, it turns it into a geographic projected coordinate system. And if you don't know what coordinate system you're on, it will give you a pretty good idea of which one you should choose. OK?

Now I love it because of the huge data aspect. In our world today in infrastructure, we're starting to deal with longer alignments, and we're dealing with larger project areas. And we

know that the limitations with an AutoCAD based application, such as Civil 3D, that engine just isn't oomphy enough. Excuse me. So InfraWorks is amazing at the ability to do huge data sets. It combines disparate data sets in data types into one model.

You'll see. We're going to use drawing data, we're going to use GIS data, we're going to do a lot of stuff and put it into one model. The visual representation without any training. I'm going to get not Hollywood realistic, but I'm going to get something good enough that any stakeholder can see what's happening.

I'm going to be able to do multiple proposals. This is again, very, very nice. I literally name proposals, and I can arrange my data to appear in different proposals and with different configurations. Again, long alignments in huge areas. The Cloud based utilities. These are awesome extra optimization features that you can sign up to use. Some of them are free, some of them you must be on subscription.

And collaboration. Everybody in this room can look at the same model. If you download the InfraWorks 360 as a trial, and use it for 30 days, and have a blast for 30 days, what happens to it after 30 days? You can tell us.

AUDIENCE: Yeah, it reverts to a viewer.

PRESENTER: It reverts to a viewer so that you have a free viewing tool so that now you can collaborate with anyone. You just can't edit, but it's a very powerful viewer. So this is what I love about InfraWorks. Now, what InfraWorks, you have to do-- understand the expectations of what you can do with it. It-- limited detail engineering, but it's getting better.

But am I going to lay out and get settings out and stake out for carbon gutter? Am I? I know.

You're not. You're going to get close, but you're not going to be able to do this. But I love it because it gets you pretty close to-- it gets you a good idea. So know the quality of your data.

The data output formats-- you have to understand which kind of data you're going to leverage. We were just talking about your BIM model and I was curious if you were doing it as FBX or if you were doing it as KML files or if you were doing it as DWG 3D models. So the data formats-- you have to understand what it can export and for what intent and purpose.

OK, the version considerations and upgrade process-- I'm just going to put an exclamation point on that and not go into it, OK? The base map in Civil 3D-- so we've got a quick start from

model builder. Again, the four things-- intelligent and geolocated.

So I'm going to bring that IMX into Civil 3D. The first thing that I need to do in Civil 3D is make sure that I am, what? Georeferenced. So we go into the Settings.

And in the Settings, we set our coordinate system. I'm going to use British national grid on this and I'm going to use meters. Who here is doing meters? OK, who here is doing decimal feet? Who's doing chains?

Utah, right? Utah. All right, so here, I've connected to the IMX file. It's telling me the coordinate system. I'm opting to bring in all of those IMX objects. I can opt to filter them and maybe only bring in the road center lines if I wish.

That's the results. That's the instant base map from InfraWorks. Looks pretty good-- I have my river edge. I have my road network and I also have these existing grounds. What do you think of that surface?

No-- all right, so now with the-- look at all the alignments that have come in. And some of the alignments even have names. So I am going to clean up this base map.

And I'm fast forwarding because you don't need to see me do the trim command and all of this. So this is the information that I need for my project. Now I am connecting to the Geolocation tool in Civil 3D.

If I have an Autodesk account, which is free, I can use the Bing aerial imagery. I don't have to find a file and look for it and attach it to my drawing. I'm just using the BIM aerial imagery. I can go anywhere and I just have clipped out that image to use in my project. So what have I done here?

I've saved myself a lot of time and I've also clipped and cropped that image, which you know if you have an image and you need to crop it, sometimes it's not so easy unless you know the tricks in Map 3D. But so cleaving up, its geolocated. I can take advantage of the imagery. Review-- instant imagery, free with your Autodesk account.

When you launch Civil 3D, it asks you if you want to use the imagery. Some areas of the world, the imagery is awesome. Other areas, it's not so awesome. Oh, right, in the handouts, I have listed a chart of how things from InfraWorks convert into Civil 3D objects.

Now, I'm going to point out a couple of important ones that-- I'm not going to go down the whole list here, but I'm going to review the important conversions and why you need to know these important conversions. First of all, a planning road versus a design road-- a planning road is sketch, sketch, sketch, you know, click, click, click. Or, it's how the fabric comes in from your model builder.

This is so awesome. You can leverage this tool. Because when you take a planning road, which looks like this, and if you click the button and turn it into a design road. it does the best fit curve function for you. So that just saved me-- if I have a long alignment and it's doing this, this, and this, I don't have to do one phase, the second phase, the third phase.

This is an easy button. This is an awesome thing. And it will turn this into that.

That looks like an engineering road. An engineering road is what? Straight tangents and curves. And when you convert this, make sure you just convert it to curves.

And who uses spirals? Bad, bad. No, no.

In my engineering practice, I know that-- just a fun side note, when the architects would give me a parking lot to stake out and they had spirals and beautiful medians and all that, well, the price just doubled on the stakeout. Now, another key point about when we bring in features from the model builder in InfraWorks-- these features must-- they must be weeded if we're going to use them to develop a BIM modeling object.

In this case, this is the pond that we're going to design. And you can see that it has 435 vertices. What would happen if I tried to grade that out?

I'm going to make such a heavy model that it's not going to be efficient for me. If I weed it out, it's going to cord things out and chop it up a little bit. But when I'm in the machine grater, my machine grater is going to smooth it out. It's not going to go clunk, clunk, clunk.

So just think about the heaviness of your model. And remember, weeding is your best friend. Key point on the bridges-- when I bring in from InfraWorks bridges, bridges-- it's an awesome addition in InfraWorks that it does model some bridges for us and we have the ability to move the peers in the abutments and all sorts of great things. When those things come into Civil 3D, they are 3D solids.

They are not intelligent bridge objects. I'll show you, though, how we're going to turn them into

intelligent bridge objects. OK, surface refinement-- adding better data.

So I'm going to show you. In this demonstration, we're going to look at the concepts of 3D and geolocation. So this is our project.

This is the project that we're going to develop in phase one. We're going to put in a pond and do some road rehabilitation. Phase two happens later.

Now, what I want to do here, and we can see I have the layout of my GIS information, which we'll see how I get this later, I am going to connect to a wealth of DEM files-- Digital Elevation Models. In this case, these are ASC files. These files are huge.

Now, you can see how many that I'm going to combine into one layer. This is magic. I'm going to take a tile of 16 of these and put them in one.

Why do I want to put them in one? There's no seams. It's a seamless combination.

All right, that's what I get. That looks really good. OK, this data, I've researched this data.

And this data is half meter accuracy. That's going to be really good for me to do preliminary design and even some final design. All right, so here's the phase one I showed you. This is phase two.

Look at the quarry. Look at the details that I got for that quarry. All right, so I've connected to data.

I've got it into my Civil 3D project. But now I need to start on the quest to turn it into a Civil 3D surface. So once it's in here, I'm going to do what's called Creating a Contour layer. Now, some of you know how to do this.

And if you do, look at the trick I'm going to do here. I'm going to make major contours at every four. So I have two meter intervals for my majors. That's what I get, OK?

This is a contour layer in the GIS sense. Now, I'm going to come in here and I'm going to make a temporary drawing with the right coordinate system and I'm going to use the Map Import tool. I could also, what? Drag and drop it in if I wanted to.

But when I use the Map Import tool, I'm going to assign data to this. So these are GIS contours and I'm going to create what's called object data and I want to make sure that I have

elevation and the fact if it's a minor or major contour. All right, so as easy as that. These videos will be available for you in case you're not familiar with this process and want to try it.

Now, once I bring this map information in, look at this. The elevation is zero. Is that going to help me?

But the object data is the right number. OK, so it's intelligent to know that the object data is telling it what the elevation of the polyline is. Anyone know how I'm going to get it done? How am I going to-- Map 3D, and what is the--

AUDIENCE: Map query.

PRESENTER: Map query, thank you very much. OK, who here has done map query to alter properties? OK, I would say a third of you have done this. OK, so we use the map W space command to get into the map 3D in Civil 3D.

You know that Civil 3D is built on a full functioning copy of AutoCAD and then a full functioning copy of Map 3D and then Civil 3D runs on top of both of those applications. So I can use my Civil 3D to do machine design and do the view base command to get all my orthographic projections instantly. So I can use it in machine design as well as infrastructure design.

So I can use the mapping tools. I can import huge DEM files. I can combine them into one raster item and then-- oh, another thing, I use draw order. This is not the CAD draw order. This is the GIS draw order and you can organize this to get your objects above and below each other.

All right, so this is using map query. Sorry about those of you that already know how to do this, but to me, this is fascinating. So I am going to turn off on my display manager my GIS information.

I'm going to go to this tab-- the Map Explorer tab. And on the Map Explorer tab, I'm going to attach that temporary drawing that had poly lines that didn't have any elevation. Now there's a concept, of a drive alias.

This is, like, I love it. It's the old fashioned part of Map that still exists. Just look in the Help file on how to do a drive alias.

All right, so now I've queried it in and I've done a quick view to make sure that it's shown up.

And now I'm querying in by location and I'm only querying in the, what? The major contours, OK?

So I'm querying everything in, but only the major contours, and I'm making sure that I alter the properties so that the elevation is assigned that object data number. So now, if I look at that poly line, boy, it looks like it needs weeding, right? Look at the elevation.

The object data says 68 and the actual elevation of the polyline says 68. So now I can use it for, what? I'm going to build my surface.

OK, now, the surface that I'm going to build-- well, first, just a quick review of the wonderful ability to attach this temporary drawing and to be able to query it in and alter the properties. OK, I queried in certain things. I only queried in major contours and then I said, you assign the object data to the elevation of each one of those contours. So property expressions are the way to do this and it's very straightforward. It helps you in our knowledge base.

You can also watch these videos. Now, for the two meter surface, I have made a container for the two meter surface. And now I'm going to define it. Now this is old school for all of you. I'm going to define it using contours.

And I make sure that my layer is isolated. And I make sure that I do what? Weeding, make sure that you weed these. Otherwise, you're going to get a heavy, heavy, heavy object.

And I do really serious weeding. I weeded out to like 8 degrees and sometimes to even, like, 10 meters in the length. All right, so now I turn the Layers back on. I do a Select-- notice that I'm doing a lot of selecting of my Civil 3D objects in the Prospector pane, not on the screen.

Who else does it that way? It's a great way to do it because you know exactly what you're selecting. On the screen sometimes you select other things. Look at this awesome surrounds surface.

OK, so now it is a surface object. I can use it in my BIM model. The last thing I'm going to do is export it as an XML.

Why am I going to do it as an XML because this is an existing surface? It's not going to change. It's going to be a very good data source, very easy for me to bring into my other drawings as I progress, OK?

So this is the 2-meter surrounds surface. This is my entire project area. Now who knows what an MMS file is? What does MMS stand for? Memory, Map Surface.

Are they good to have these files or bad to have these files? You should avoid these at all costs. A Memory Map Surface file means that it's too big to hold the whole surface in your current drawing. And it pages out and stores it externally.

OK, you come back a week later. You check it out of Vault or check it out of ProjectWise or get it off your server, and it can't find the Memory Map Surface, big, big trouble. Or you check it out of Vault, and your Vault looks for 3 hours for it.

So avoid at all costs creating Memory Map Surface files. To do this, you just make sure that your surface is no larger than 2 million points. If I have a 40-million-point surface, I just cut that down into multiple surfaces and have multiple XML files or data shortcuts. So please, please make sure that you do not go over 2 million. In my work, I can't tell you how many people have ruined big, big infrastructure projects because they don't follow that easy, easy tip.

I would say that-- and they blame it on Vault. They blame it on ProjectWise. They blame it on their users. They blame it on their own hardware.

It's nothing more than an MMS file. So make sure that you look at the number of points. Now that beautiful 2-meter surface that we have that shows all of the details I need is only 94,000 points, well within the limits. But yet it gave us enough information.

All right, here's another tip on bringing in surfaces from XML files. Make sure, make sure when you import an XML file to be used in your project that you turn off-- expand this. Make sure you do it by default. This is toggled on.

Now if you keep that on, not only is it going to bring you the surface, what else is it going to bring? It's going to bring all of those contours. If you weeded them, great. If you didn't, you're going to have a lot of extra CAD in your model, and we don't need it. They don't serve any purpose on an XML file that is a file that is an existing-condition file.

The surround surface, now why am I working with a 2-meter surround surface and not a detailed surface? Well, the reason that I didn't make our entire project a half-meter surface is what? Size, and the fact that if I'm outside my area of interest, probably the only two things I'm going to use are visualization-- have the aerial imagery draped on these-- and hydrology.

And when I do my watersheds, and when I, you know, figure out my pre-development cue values, and I do my time of concentration, I can do it perfectly with a 2-meter refined surface, but not a precise detailed surface. Does that make sense to everyone that the surrounds do not have to be my half-meter accuracy? That we can perfectly do our hydrology on a surrounds-type surface, and we can also do our visualization with a surrounds-type surface.

OK, getting back into surface simplification. Now this is the TIN lines of those ASC files. Remember all the 16 that I dumped in from the GIS, the mapping?

So look at how many points. At every one of those intersections would be a point. Now when I converted it to contour lines, look at how many points I have now, just where the black big TIN lines go. So you can see that I have taken out each one of those tiles that made the green digital terrain map was a million points each.

So that means if I brought in 16 tiles, I had 16 million points in that surface. And you saw, by the technique I used, I brought it down to less than a 100,000 points. And I haven't lost any fidelity because for the intent and purpose, it's perfect. OK, make sense?

The surface management with the XML file, so here I have my two phases of detail, phase 1 and phase 2. And I'm going to bring in for the surrounds surface. And there is the expansion and the clicking off, the toggling off, of the source data. How many knew about that trick?

All right, so there's my surrounds surface. That's going to be for visualization. That's going to be for hydrology.

Now this is the half-meter surface. I made the half-meter surface with the same technique of querying in from Map. And the half-meter surface is where I'm going to do my detailed design. All right, and so there's the results.

So know your areas. Know the intent. Know where it's going to be.

Now here is a quick profile showing the difference between the 2-meter and the half-meter surface. And you can actually measure the difference on those profile views. And you can ask yourself if this is going to be adequate or not. But make sure you use these nice surface analysis tools, these visual tools, to make sure that you understand the project.

All right, let's take a look at the 2 meter again. We can see now-- oh, it's 270. OK, so a little bit bigger on this one, so it's still way less than 2 million points.

And these are the surfaces in my Surface collection. And if I want to do data management, now I save this drawing, and I create the data shortcuts from this drawing. And this now becomes what? A source drawing for my surfaces data shortcuts.

I just wanted to show you the possibilities. OK, in the example I'm going to do today, I'm going to use just XML files. I'm not going to do data shortcuts.

All right, adding traditional data, so far, we've build a Civil 3D surface object. Does that qualify for BIM? Yes, no, or maybe? Is it 3D?

AUDIENCE: Yes.

PRESENTER: Is it georeferenced?

AUDIENCE: Yes.

PRESENTER: Does it have attributes? If I take my mouse and scroll over it, do I get the elevation?

AUDIENCE: Yes.

PRESENTER: Do I get the name of it? Is it on a layer? It's attributed, OK? And then what was the fourth concept to BIM to make it BIM-y. It has to be dynamic.

What would happen if I put an extra point in there or if I did bring the contours in and change the contours? What would happen to the surface?

AUDIENCE: Change.

PRESENTER: It would change. So is it a BIM object? Yes, it actually checks up all four of those boxes.

But let's look at things that aren't BIM-y. All right, the key characteristic, we're going to add survey points. And we hope to heck they're geolocated, all right?

But they're not 3D. I mean, they do have some intelligence though. But let's look how this works.

Here is our base map. There is our lovely surface. We're going to turn it off. It's still there, but we just don't need it. The intent and purpose is not to show it.

I am going to open the Survey Database. And I'm simply going to drag and drop my survey

points into the drawing. Now I showed you that currently in the drawing, there's no point groups, but now I have dragged and dropped some control points in. If I go to the Prospector tab, I now have automatically created point groups. Whenever you take in survey data into Civil 3D, it automatically creates the point groups if you drag and drop the point information.

Now the next thing we're going to do is we're going to get the edge of the river because this could impact our project. Now I could spend all afternoon doing what, connect the dots? Or I'm going to make sure that I use the Process Linework command in correlation with the what? The Figure Prefix Database, make sure that we toggle those on.

Oh, that just saved me what? An hour of work and carpal tunnel. OK, so it is a Survey Figure. And the reason that it worked is because in the Figure Prefix Library, the description of the point was called River, RVR.

And notice that it automatically put it on a layer called River Edge. I didn't have to have that layer existing in the drawing. It automatically made a layer.

All right, so now I can remove the survey database stuff from the drawing, and I'm left with what? I'm left with this line. This line work that is attributed because it's on the correct layer. And I'm going to use the Map Export command, and I'm going to turn it into a shape file.

Now the reason-- oh, here's another neat thing. When it is a CAD item, I can take things such as the length of the perimeter and the area of it and turn it into smart information that will live on the BIM object. I'm taking CAD stuff.

And we know if I'm doing the surface area of, say, a landscape yard, that I can easily get it from CAD. I don't have to figure it out or add it in by hand. It automatically happens. And then you saw I dragged and dropped it right into our drawing. OK, if we look at the theme, you can make it any color you want, very, very easy to do.

So the aspect of using these little tricks and tips from GIS is incredibly important. The other fact is I mentioned Layers. Layers is an interesting way to carry BIM attribution from cradle to grave.

It's the only attribute that you don't have to really work with that will carry through from the most primitive AutoCAD all the way through to your most exotic BIM model. It's the layer, so make sure you use logical layer naming. So the power of the survey database, we use the Figure Prefix Library to automatically connect the points.

OK, now the next BIM-y thing we're going to do, if we can look back in the history of development of infrastructure, before the era of CAD-- when did CAD start? When did Autodesk start?

AUDIENCE: '84 maybe?

PRESENTER: Yeah, yeah, '84. And, some of the people of my era, when did you start using CAD?

AUDIENCE: [INAUDIBLE].

PRESENTER: 85, 85? Oh, I sold my car in order to buy a copy of AutoCAD version 9. I sold my car. But within like six weeks, I had earned enough money from the architects in my town to buy a brand new Ford F-250 truck.

[LAUGHTER]

All right, so CAD came in from 1985. And you guys probably started using it in the '90s. You know, it's really caught on.

So GIS has also been around for a really long time, so we're in this era now where we have lots and lots of legacy data. How do we make it Bim-y We're going to give it BIM character. I mentioned Layers and object data, so the characteristics of BIM, we're going to turn it into 3D objects. We're going to make intelligent and geolocated.

Here's a paper document. Now, I'm using the Raster Design input, add-in, to Civil 3D, and I'm taking, from my flat file, and I've scanned a paper document. And this paper document, the goal is to get the parcel outline for this water treatment plant without having to hire the surveyor. Sorry putting you out of business. [LAUGHS] No.

So this is the parcel plat that could be pre-anything, and we're going to change the color depth. So all I've done is I've put it into my model anywhere. I don't care.

And now I've turned it into what's called a bitonal image. It looks horrible. So I'll invert it, so it's now readable as black and white. And I can see that the surveyor did use control points because when you do a plat, you have to put in some kind of control and a baseline and all of that.

So I've put the image in on the side. There is the base from InfraWorks. I've dragged and

dropped the survey control points in like I did earlier from the survey database.

Now I'm going to quickly connect the dots. I'm just going to use a polyline and use the point numbers, and I'm going to do point number 1 through 3, comma 1. And it's going to go pfft, like that.

Now imagine if you had a thousand points. That would be a time saver. So I drew the control triangle, the reason being it's just easier for me to see the endpoints.

Good old AutoCAD Align command, and I'm going to pick that image, and I'm going to align the upper-left control point with the northwest control triangle corner. And then I'm going to go to the northeast control point. Now this is not spot-on, but it's close enough. I'm not going to put my engineer stamp on this parcel outline, but it's going to be close enough for my design.

All right, the align command, just two points, and, yes, you scale it. Now what this has done, it's brought it in. It's georeferenced it, and it's scaled it. And then you saw, I changed the layer. I'm changing the layer, and the next thing I'm going to do is I'm going to use a vectorization tool.

And I'm going to pick on the outline of the parcel and just click once, and look what it did. It brought the parcel boundary out, put it on a layer that tells it it's the parcel boundary. And now I erase the image because I don't need it anymore. And I don't need the control triangle either, and now I've georeferenced it, OK? And there it is in a GIS environment.

AUDIENCE: Why wouldn't you have just taken it one step further and rubber sheeted that to make sure the image was a bit more accurate?

PRESENTER: Because I looked at it. It was close enough.

AUDIENCE: It was close enough?

PRESENTER: It was close enough.

AUDIENCE: OK.

PRESENTER: Yeah.

AUDIENCE: But that's an option if you want?

PRESENTER: It's an option. But then again, I don't want to assume that this is going to be my real parcel data. But rubber sheeting is an option. If it's really far off, you can use the nice correlation tool of rubber sheeting to do that.

The other thing I want to point out, I had a client the other day. And they had lots and lots of legacy data that they needed to bring into their infrastructure project, and it was architectural feat and decimal inches. And they actually took the time to retrace out the building outlines. And the poor operator, with a calculator, converted the dimensions to metric. Can you imagine?

OK, all they needed to do was take their scan, put it in something like this, and automatically, when it scales and rotates, it doesn't care if it's in inches, millimeters, whatever, it's going to make it the right scale. And just that one trick, I thought this CAD operator was going to cry because all of a sudden what took weeks and weeks and weeks could be handled in a matter of an afternoon.

AUDIENCE: Can you adjust vertically [INAUDIBLE]?

PRESENTER: Uh, hold on. The question was, what about the elevation? Now the next thing we're going to do is we're going to take some CAD work. We're going to fast forward here, and we're now in the 1990s, and we're dealing with an architect.

And so we're going to xref in an architectural drawing that was done in CAD, in AutoCAD or maybe some other CAD product. And I'm going to just put it in anywhere. Again, it just has to be somewhere near my project.

Now this is an architectural drawing. Again, it could be in any kind of units. And I don't have survey control. How am I going to get this georeferenced?

AUDIENCE: [INAUDIBLE].

PRESENTER: Thank you. The image, it's very obvious. Oh, here's a cool tool. In an xref, if I use the Create From Feature Lines, in Civil 3D and right-click, look what you can do. You can pull lines out of an xref.

Look what I'm going to do. I'm clicking on the xref. Bam, I've pulled that and made it a CAD object in my current drawing.

Who knew that? Shoot I thought I was showing you-- about a third of you knew that. OK, again, layer, I'm being very specific to put this on a layer because logical naming is something you need to start to really be aware of.

OK, now this has been brought up into our georeferenced world. And we're going to use the Align command. And in the Align command, we're going to align it up with the towers.

OK, again, this is not going to be exactly perfect, but for our preliminary and close-to-design process, there it is. Oh, by the way, I also did the Which command to make it 3D.

AUDIENCE: [INAUDIBLE].

PRESENTER: Extrude or PressPull, so I did take the CAD, and I did extrude it up just a little bit. Oh, where did I get the numbers to extrude it from? The architectural plan. There was an elevation. I just typed in the numbers.

OK, so now I've taken stuff that wasn't BIM-Enabled, and I've turned it into a BIM-Enabled object. So the xref, remember that if you use the Feature Line tool in Civil 3D, you can pull CAD objects out of an xref. The layer as an attribute, it's important that we put things on the correct layer.

Now the next thing I'm going to do is I'm going to take in GIS data, and this happens to be a pipe network. Now the pipe network, as we can see, I just dragged and dropped this GIS. This happened to be a shape file. It was two different shape files. And if I look at the object data, it's got an awful lot of information.

It's got the x-- the northings and eastings. It has the inverts. It has the pipe names that are connected to it. It has a wealth of information.

This could have come from a variety of different piping packages, hydrology packages, whatnot. All the information is there. And it looks like it's in the right spot.

But let's take a look at this. I'm going to select this information, and I'm going to put it in the Object Viewer. Is it 3D? It's not 3D at all. So I need to use a CAD tool, and I need to convert this into a 3D Object.

OK, I'm going to connect to the shape file, and we're going to use the Wizard. And the Wizard is going to allow us to-- first of all, I have to do what? Georeference it, and I know that it

happens to be in the British National Grid, so I quickly give it the coordinate system. And now I step through this Wizard. Now this is a utility in Civil 3D.

And now I take the object, the Civil 3D object, and I am going to correlate it to the feature class data. So here we go. I'm loading up the data.

And we can see that this is going to relate to that component in Civil 3D. And when I step through this, I do this for both of those features. And once you set this up, you save the mapping so you can do this over and over again.

OK, the next thing that you must do is you have to make sure that you put a snap on this. Give it, like, a quarter of a meter so that the pipes know to connect automatically to the structures. If you don't check that Snap on, it won't work.

All right, now this brought this in. It turned it into what? 3D objects with lots of attribution. And if we select it and look at it in 3D, we can see that they are real objects. Can you imagine if you had pipe networks from a variety of sources, and this would save you a lot of time.

What if I had a thousand structures and 1,001 pipes, OK? So I've BIM-ified this. So feature class attribute mapping, and we correlate it to the equivalent geometry in Civil 3D.

OK, so now, what I've done is I've refined my base map. So I've taken what I got from the model builder, and I've refined it more so I'm feeling better about doing my design in my area of interest.

AUDIENCE: What about the [INAUDIBLE] brought in? Once you got that output [INAUDIBLE]?

PRESENTER: Yes, the question is once I use the GIS converter tool, the GIS information is still there. And so you probably just want to unattach it from the drawing. Don't erase it because it's a mapping feature, so just turn it off. So now we're going to bring this back into InfraWorks. And I'm going to bring it in as an IMX, a shape file, and a 3D drawing because of the different ways this data is going to come into InfraWorks.

All right, I'm opening up my InfraWorks from a local drive. You saw how big it was. It's starting to get to be 30 megabytes big, and it's going to get even bigger. But that's OK. We have modern hardware.

OK, it's crucial that you make a proposal. And you name these proposals so that at any time

you could roll back or start from the existing conditions all over again. So make sure that you start to build proposals.

OK, there is my-- I'm connected to the data sources. And I'm going to remove some water areas that I don't need. And now I'm ready to-- there we go-- now I'm ready to start bringing in the refined data. So I'm going to slide down, and I'm going to bring in the IMX.

All right, this is going to connect, and these are the items that IMXed out of my Civil 3D drawing. Now you can see that they show up in blue in my Data Sources file. Now this is a key concept when you bring in data from a different source into InfraWorks. You must, you must right click and configure it.

Even though it says it's configured, right click and configure it. Sometimes it's just an easy button of Close and Refresh. Other times you have to fill in some details.

All right, so that brought in my pipes and my structures, a right click and a Configure. And why can't I see the pipes? They better be underground.

All right, now I'm going to bring in the 3D plant drawing. It's telling me that I need the cloud to do this. If you have Navisworks and Civil 3D loaded on your computer, it does not need to go to the cloud. Again, you can do all of this processing local. And if anyone wants to know, I'll show you where you set that option to process it locally and not go up to the cloud.

Now here, I must right click and select-- now here's a little bit more of a serious configuration. You have to tell it what it is. I'm telling it it's buildings. I'm telling it what coordinate system it's in.

And if you want, you can give it a tooltip. And on the tooltip, I'm actually going to use one of the properties, very easy to do. And I'm going to use the name of the file as the property.

So go to the HTML tab, and go to the little tag that says Properties. Always, always look at the model, especially if it's a 3D model. Make sure it's not upside down and backwards. Sometimes with FBX files, it does some funny things. And you can easily fix it before you bring it in.

Now you're going to see it pop in. Did you see it pop in? All right, so we brought in the 3D, so that was a drawing. So we brought in the IMX information. We're bringing in drawing information, and now I'm going to bring in shape files. And the shape files I'm going to bring in

are the treatment plant and the edge of the river Severn.

So we'll bring it in. We'll have to configure it. We want to tell it that it is a waterway. Look at the selection of feature types that you can add, and hopefully that list maybe will get more robust. And I'm going to make sure it's the right location for the source.

Here's this elevation question. I'm going to actually drape it on my ground because I trust that 2-meter surround surface. And if I want, again, the tooltip, the name, and Close and Refresh, and you'll see that this will bring in our river. And it has a tooltip.

All right, the last thing we're going to do is bring in the parcel boundary simply because in our area of interest, I need to know where these things are. And when we bring in the parcel boundary, we probably want to add a style to it. OK, to do a style, there's the treatment plant. We put a tooltip on it, and I'm going to go over here to the style palette.

And in the style palette, there's lots of styles for different features. I'm going to simply drag and drop this over. It's as easy as that. Just drag and drop your styles on. And now we have our base map.

Oh, and let's take a look at the base map. Let's see if everything got brought in correctly. We're going to fly through this. There's the river.

I can see that the edge of the river has done nicely. As I come across, I have an old swale from an old road that we're going to get rid of. Now I come in. I see the massing of my 3D drawing for the treatment plant. I see the parcel in green, and as I dive under, there is my GIS converted to a 3D object.

So what we've done is we've taken legacy data, and we've BIM-ified it. So now I'm starting to congregate and build a one-source-of-truth for my BIM model. And I'm doing it in InfraWorks.

OK, why is GIS data so important. I was so happy. This side of the room agrees with me. GIS data, there's an awfully lot of it. There is a huge amount of GIS data available, and it's used in many, many different operations.

I can do my hydrology analysis. I can do my pipe and water analysis in some-- whatever my local tool is. And you probably, 99.9% of the time, can export that analysis as a GIS-type file.

OK, it has attributes. By default, that's what GIS is. It's geometry with lots and lots of

attribution. And GIS also, by default, georeferenced.

And it can be displayed, as we saw, in 2D. Sometimes I have to do some tricks to get it in 3D, but it's 2d and 3D. So it checks off all of the boxes except Dynamic. And maybe we could argue about that one, but GIS data is-- do not forget about using GIS sources.

All right, here is designing your layout in less than six minutes in InfraWorks. Who's played with InfraWorks? OK, so this is old hat to you guys.

So this is the area in question. I'm going to do a lake. So the pencil is the Editing option. And the features that you can do, I'm going to do a water area.

You click on the Style. You can turn off the Asset Card here. And you can just click and click and click.

Now, it also is giving me a nice heads-up display of the surface area of my lake. So if you know that you need to keep it under a certain area, you can use that nice heads-up display. There I've turned on the glyphs and grips so that I could further adjust this if need be.

So that's my pond. Now, I could start to put in a planning road, but I am signed up for the feature of design road. So I'm going to up the ante, and I'm going to create a design road.

I'm going to pick a nice, compelling style. It's a sidewalk with lamps. And now I sneak in here, and I hook it to an existing road. Just by hovering, you can see that you can hook to an existing feature.

And look at this, it turned it into something that is very Civil 3D-like. I see a tangent. I see endpoints.

If I turn it up on its edge, it automatically sensed that it went over water and put in some kind of piers to support it above the water. And now I can give it a profile view.

It's showing me the water bodies. And it's showing me this temporary finished grade profile that I can-- when I select here, it mimics it in the actual visual view. And I can start to adjust my finished grade. Notice when I pull this up, I'm getting, again, the instant feedback so that I'm not going to design an 18% grade going up my bridge.

All right, so we can use the glyphs and grips, not only in a traditional civil engineering profile-view sense to get the VPIs set. I can also do it visually. OK, I'm just getting this close. Now you

can start to actually type in numbers on these VPIs, but sometimes it's a little tricky.

All right, so that's the results of this. And we're going to export this out. I'm going to export this now as the next phase of my model.

So I had the original one, which was the model builder. And now I'm going to do the same IMX export. Use the bounding box. And that is design layout in less than six minutes.

Who's done it in InfraWorks? Most of you have done it. Is it fun? It's really fun.

What bothers you the most, the fact that the mouse buttons are all backwards from your CAD mouse buttons? This is better than playing video games at night. All right, now we're going to bring the IMX design back into Civil 3D so we can start to do some serious design work.

The coordinate system, I can elect which items to bring in and not bring in. I'm using refine the selection set. And in this case, I am going to limit a lot of what I'm going to bring in because I don't want to spend time cleaning up stuff that's not relevant.

OK, we'll open up that model. It's bringing in 71 entities. OK, now once this has brought this in, I have made a copy three times over because I want to demonstrate the concept of a good BIM project.

I'm going to send one drawing to the pond people and the hydrology people. I'm going to send another drawing to the people that are going to set this up for the bridge and structure designers. And then I'm going to send another copy to my landscape planners or the people that are going to start to lay out the subdivisions.

So I want to have parallel processes happening at the same time, from this same base map information. Is this a good thing to do? The reason I can do it is that the objects that are going to be returned to me are going to be civil, dynamic objects. So when the bridge people come back, and if the bridge impacts my pond design, I can probably easily move the pond design without having to go back to square one. Does that make sense, that we want to try to invoke a parallel workflow and not a serial workflow where one happens right after the other?

All right, let us go into Civil 3D. Should we do some of this live. Let me open up a drawing. And let's start with the bridge. Let's start with bridge design.

So this is opening up that base map information, and it looks just like what you saw in the

PowerPoint. It is, of course, georeferenced, so if I want to, I can use the geolocation. I can turn on the aerial mapping. Yes, I want to use it. And, actually, it probably won't work because I'm not connected to the internet, but that is the scenario that you're going to see when you start this.

On the Home tab, I'm going to come in here, and my goal here is to create a corridor so that I can start to identify the critical points for my bridge people. So there is the Plan View. Here is the Profile View. Here are some of my very, very primitive cross sections, my assemblies. These are going to dictate what happens on the width of the bridge deck.

All right, so the first thing I'm going to do is I want to create a corridor. On the corridor, we're going to call this-- let's call it New Lake Road. OK, the alignment is going to be New Lake Road. The profile, make sure you get the right profile, and this is the finish grade of New Lake Road.

The assembly, I've got several here. I'm going to do the primary road full section. And we're going to target that fine surface, that half-meter surface. We're

Going to go ahead and build this. All right, and then I can select on it. Put it up into 3D in the Object Viewer.

And what do we have? If I had a dime for every time that happened, we could all go out to dinner. And I say that in all of my classes because I know this happens to all of us.

So two things I want to review here, actually three. The beginning of my corridor is falling off-- the profile extends the alignment. And at the back, I've extended too far off the back end.

Also, notice that I am daylighting into my river. I don't want to do that. So first thing I'm going to do is sneak in here, and this is an easy fix. Just with the Grip, just come in here. And if you turn on the Object Snap, that will fix that.

Now that was a dynamic update. We saw that that instantly fixed. Now I'm going to need you to help me to remember some numbers here. I've identified a critical station where a bridge abutment should be.

So I've made the numbers easy. That's Station 100. And I want this to span all the way across both bends of the river and the lake. And this station is 880.

And then at the end of my project, I wanted to stop at about 1,000. So those are some numbers we need to remember as we go back into the corridor object, and we set some of the properties. So in the parameters, I'm going to go to station 100. I'm going to add a region after, and that is going to be a region that is just the deck. I don't want it to daylight, so I don't have any daylight subassemblies in there, and we said it goes from station 100 to station 880.

All right, then I'm going to add a region after. And that goes back to the full primary road with daylighting. And I want that to end at 1,000.

Whoops, click in there. We have 1,000. And I want to Review to Set All Targets. Click here to Set All. Do OK and OK.

Now when I select my road corridor and put it in the object viewer, we're going to see that now it is looking like it should, that I have the approach where the abutment would be. And I have the span across the water with no daylighting. And then it lands on the north side on the north abutment.

OK, now that I have those conditions set up, I'm going to launch the Bridge Modeler. And the Bridge Modeler, let's just pick a simple box girder. We have other selections that we can do. I'm going to select on this. This is going to take time to load up with this add-in Bridge Module Tool.

Now the corridor, I have to make sure that I'm using the correct corridor. It's the New Lake Road corridor. The baseline is the alignment centerline. And the profile is the finished grade of the New Lake Road.

Now the region, we had three regions. I want to make sure that the bridge goes in what? The middle region, OK, so make sure when you do this the first time that you look at all of these selection boxes and just don't go OK because you'll get the wrong answer.

And also, the terrain, where do I want my footings to land? Well, I want that to land with the pond and abutments. I'm going to do OK. Now this is going out, and this is working and building a bridge for me. Well, that happened pretty fast actually.

Now this is giving me the bridge layout from a Plan view at the top. And we can see, if I zoom in here, all of the different structures that it has put in. And in the bottom, if I slide down, it has put in 38 supports.

I'm going to be quite cavalier about this. And I'm going to select and only make a bridge with eight piers. So I'm going to remove-- oops, not clear. Oh, no. Cancel, oh, no.

Let's review this one more time. Sorry about that. [LAUGHS] It's the middle, and we get the correct-- OK, it will quickly redo that.

AUDIENCE: [INAUDIBLE].

[LAUGHTER]

PRESENTER: Thank you. You make me feel better. I might have to bring you up here to drive.

OK, Select, and we'll bring it back to you just before eight. Right there, I will click Remove. That's the one to do.

Now you can see that all of my supports are located here. I'm going to click on Arrange. And that then puts them back in equal spread.

Just to show you how this works, if I zoom in here, I'm at my first station, which is, roughly, at 192. So that's this item right here. If I do a skew angle, and if we put in a skew angle of like 45, you can see that it instantly updates. OK, and I'll put that back to 0.

All right, let's look at the Deck options, flat or crowned. The Roadway option, again, there's only one roadway option, and that's a crowned road. The Barriers, I can have them skewed or plumb. The Abutments, on this abutment, I do want to have wing walls on the abutment. I have to look at the Heads-Up display down here to make sure I'm putting in the proper angles.

So let's look at the left wing angle. That's this angle right here. That, if I wanted to flare to the outside, that's going to be a minus 45. And this one is going to be a positive 45.

All right, the Piers, I don't have much choice on the piers. And the Bearings, again, I'm left with the defaults here. Where is it getting all these numbers? It's pulling these numbers from that corridor model to get the width set up.

Now it's creating the bridge as a series of 3D solids. And it will put these into the drawing. But I can also now export this to my Revit structural people.

And the reason that I'm giving it to them in this format is because I've done some of the heavy lifting because I've identified exactly, using my critical points along the station, where I want

those abutments to be. They're going to probably change a lot of things, but at least I've given them a good jump start on where they should be. And I know that I don't get paid as much as the structural guy gets paid, so I want to do as much of the work as possible before I turn it over to him.

OK, so we have this. Another thing that's really nice in the Bridge Modular, if there was an error, it would give us a logical error message. Let's see what this looks like. I'm going to right-click and do a Quick Select. And in the Quick Select, I'm going to look at my 3D solids, and I'm going to do Select All.

I'm going to select the Terrain. And let's put this in the Object Viewer, and let's see what we've ended up with here. So we've ended up with a pretty nice start on the bridge design. OK, and it's matching up where I want to be on my endpoints.

All right, so that's it on the bridge design. And we're going to fast forward. I wanted to show you the pawn design. We could probably do a pawn design pretty quickly and the residential design, but let's fast forward and look at how we're going to bring this back into InfraWorks.

I'll just give you a heads up that this is my pond design. This is the layout for my residential pad, grading pad. And if we revert to InfraWorks, and I'm going to go into the scenario of the finished grade and bring in all of those items using what, an IMX file? Using XML for the surfaces and using 3D for the bridge, if I want to bring the bridge in.

And we can see that, from the layout, I brought in some townhouses. From COGO points, I've brought in trees, new trees to be laid out. And we need to present this using the storyboard.

So that's this icon that looks like a television. And I'm going to go to the Storyboard Creator. Now the Storyboard Creator gives us the ability to create a new storyboard. And I like to use the technique of adding a camera path animation.

And the way this works is I set up a nice view, and I take what's called a keyframe. So using that camera path animation, you will add a keyframe. I will put a keyframe here, and then I simply pan to another area of interest and add the next keyframe so on and so forth. And then it automatically does all the cinematography to do this, OK?

So the key is key frames. And this is what one would look like when it's finished. I will play the storyboard, I have made a couple of keyframes here. And the storyboard, I'm going to hit the Play button, and let's see what this looks like.

So I swoop in to my 3D building. There is my finished bridge deck complete with rails and lights. And there is-- oh, I've selected the intersection. I'm flying up a brand new layout road that has been turned into a design road.

Now if you haven't tried the intersections in InfraWorks, you didn't see me make intersections in Civil 3D. Oh, there's another bridge. And, again, that was done just by putting a style in. We're going to fly up and over.

Now notice I don't have my [INAUDIBLE] detail. And remember in the very first part with the green, I did a [INAUDIBLE] surface. I haven't pushed that into my model yet. I'm going to come back down here, and we're going to fly back. And so now all of you stakeholders can see the efforts of the work that simply started from a little square in Model Builder.

So the MacLeamey Curve, to finish up my lecture on BIM, we have seen how we can use Civil 3D and InfraWorks to do the MacLeamey Principle. And the long story short is get your project shortened significantly by doing multiple tasks at the same time. And also, leverage early, early on, BIM designs because it's easier to fix it in a model than it is when we're actually moving dirt on the ground. The dynamic interaction of all of the objects that we've just talked about is key in making this work. And the collaboration, everybody in this room understood, whether you are technical or not, what was happening in my project.

If something changes, is it catastrophic? Let's go to this drawing here. And, all right, if I have to move something or change something-- oh, and this is probably not the drawing to do it in. Let's go for a pond drawing.

OK, so now this is the pond grading, and it's going to load this up and a change. So this kind of wraps everything up with the concept of dynamic. There is my pond design. You can see the grading object. And let's say that we need to put in a bridge structure right here, and it's impacting on the pond.

So I pick on the defining line of the pond. I use grips. I'm going to pull the grips. Those were just warnings, not errors. Oh, what happened?

AUDIENCE: [INAUDIBLE].

PRESENTER: Who told me to use Object Snap? OK, and I think you get the idea. Let's get this moved out again. I need to pick just on that feature line, very carefully move that. And we can see that

everything is instantly updating.

What does a yellow shield mean?

AUDIENCE: You've got to rebuild it.

PRESENTER: We've got to rebuild it. OK, so dynamic abilities-- thank you very much for sitting with me for the last hour and a half. Hopefully, you're still awake and that you now know the four concepts of getting your BIM into your infrastructure projects and using Civil 3D and InfraWorks.

Thank you very much. And please fill out the form. And you could win a pass for next year's Autodesk University. Thank you guys very, very much.

[APPLAUSE]