**RUSTY BELCHER:** So I want to go ahead and get started. Welcome, you guys. My name is Rusty Belcher. I'm an application engineer. I work with IMAGINiT Technologies. We're a reseller for the Autodesk products. And I specialize a lot in the mechanical and the manufacturing side.

I got my t-shirt down at the store, and I put Inventor on mine. So if you had to pick a tool to represent yourself, I think I'd pick Inventor. For a long time I thought the F stood for Factory Design Suite but apparently it stands for something else-- Fusion.

So today we're going to take a look at point clouds and how you can utilize point clouds in Inventor, with the Factory Design Utilities. I hope you guys will see some stuff today that kind of, resonates with what you've seen with AU this year. How many of you guys have seen a virtual reality presentation this year? Anybody check those out? Anybody put on the headset down on the floor and looked around?

One of the topics that's coming up quite a bit this year is scanning assets for use inside of virtual reality. Now this is the second year I've done this class. We talked about this a lot last year-- about scanning assets for use in your CAD system. So it's kind of neat to come to AU this year and see so many people thinking about going out, capturing reality, and using it in their software package-- whether it's VR, AR, Inventor, your desktop applications-- it's really exciting to see people coming on board with this.

So I hope you guys see some stuff today that-- whether you're a Factory user or not-- whether you're going back and working on factories, it really doesn't matter. I hope you catch on the idea of how to take real world objects, get them into your CAD system, and start generating your classic documents from point clouds. So let's take a look at just the class summary.

I mentioned before of-- reality capture is everywhere now. Reality capture used to be such a very, narrow focused little thing. But now, if you have the Product Design Collection, the Product Design Suite-- you have reality capture tools built into your installation. You have them already. There's so many places to get point clouds now. Has anybody here done a point cloud with your phone yet? Anybody got-- what is it-- 123D Catch? Gone out and taken-- what-- 50 pictures, and submitted it for a mesh. Maybe you can 3D print that thing if you're lucky.

Reality capture is becoming commonplace. I saw a phone down on the floor. Built into the phone is laser scanning-- or capturing capabilities. Very, very impressive. So it's no longer--

you know-- $100,000, $200,000 entry fee to be into the point cloud environment. It's now accessible to everybody. And you want to make use of these reality captures.

Now of course, you guys have been to class. I hope-- I would imagine-- this is your last class at AU. I appreciate you guys being here. I really do. I kind of thought that this place would be empty. They told me that I was the last class and I'm like, well-- the first thing I said was, save the best for last. And then I thought, well no one's going to show up for this. But I'm glad you guys are here.

So you've seen, every class starts off with the four topics that we're going to take a look at through the class. This year-- this is a little bit different than the class I taught last year. There's been a couple of changes in the software and I wanted those to reflect in the class. So we're going to change things up a little bit from last year.

But we want to talk about ReCap. I asked you earlier, how many of you guys are using it? If you haven't used ReCap, I'm going to give you a little introduction to ReCap-- what it's for, why do we need to use that.

We want to take a look at how to create DWG data from a point cloud. I need to take a cross section of a point cloud and get the line work for downstream processes. A lot of ways to do that nowadays.

If you are interested in the Factory Design Utilities and want to take a look at how we can utilize the Factory Design workflow-- to take these assets that we create from reality, into your CAD system-- and what are the benefits of that. And then we'll investigate the possibilities of using a point cloud as a factory asset. It's not possible anymore. It's real-- it's here. It's very commonplace these days to have this conversation with customers.

So Autodesk ReCap. ReCap stands for Reality Capture. I was so pleased to see such a ReCap presence on the floor this year. It seemed like-- whether I was in the civil side on the exhibit floor, the manufacturing side, the civil side, the architectural side-- everybody was talking about scanning and ReCap, and getting that data into their specific CAD system.

I'm going to narrow the focus. I'm here today to talk about the Product Design Collection. So typically, AutoCAD, Inventor, Navisworks-- now-- thank goodness. If you want to use a point cloud in those CAD tools, you have to put the point cloud into ReCap first. And then, take it downstream into your CAD applications.

Think of ReCap as the funnel-- the door-- that allows you to bring reality-captured laser scans into your CAD system. Ages ago, we used to be able to do this right inside of AutoCAD. It didn't matter where the cloud came from-- like FARO or any of the other scanners out there. You could actually register the cloud and compress it, and process it to get it into your CAD application. But that's not the case anymore. You have to bring in the cloud-- through ReCap-- into your CAD applications.

Up here is a little-- this is on the handout, so hopefully if you-- please-- take the opportunity to download the handouts for the class. I know this is hard to read, and you don't want to record this, but these are the file types that are accessible-- the point cloud file types that you can open with AutoCAD. There are two point cloud types you can open with AutoCAD-- A ReCap scan-- an RCS, and a ReCap project-- RCP. And the same thing with Inventor. Those are the only two clouds that you can bring in-- the only two file types.

With Navisworks-- really Navisworks is such a mature product-- it's been around for almost 25, 30 years. It reads clouds from all types of cloud scanning sources-- FARO, LYKO, all of the major scanners out there-- it reads it. If you've ever gone to a presentation on laser scanning-- I'd just about guarantee you-- the people doing the presentations have Navisworks.

If you're new to clouds, they are massive. You're talking a point cloud-- you're talking in the gigabytes of data. So you need a tool to take that massive file, make it work on your computer, and then hopefully clean it up-- make it smaller and smaller-- so that I can go take it and use it in my CAD system. And it won't bog my Inventor, or my AutoCAD, or my Navisworks down-- if I want to use that big file.

And that's where ReCap comes in. So I'm going to sit down and start doing a little work with the applications here. I want to focus on ReCap first-- what's it for. So right off the bat, in most cases you have to clean up your scan.

When you take the laser scanner out, you scan the entire world. And when you bring it back to your office, you just want a little piece of the world that you're interested in-- a piping system, or an HVAC run-- or something along those lines. So you need a very efficient way to get rid of all the points, except for the points you need for your CAD design. That's where Recap comes in.

You also want to orient your design. Everybody knows what a UCS is inside of AutoCAD and

Inventor-- right? Well the scanner doesn't know that. When you go out to scan, it just arbitrarily, in the very first scan-- that kind of sets up where the xy and z is for the entire registered scan. You need a way to change the orientation-- that coordinate system for the point cloud-- so that it matches up with the coordinate system in your CAD product. Where is your origin? Which way is the z-axis point? Which way is the x-axis point? ReCap allows you to do that.

There are two ways to get rid of points. You can hide them. If you hide points, your file size is exactly the same. You might pick up some performance on your graphic side because you're not showing the points. But you can also delete points. Let me go through there. Deleting points makes the file smaller. It gives you a little bit more-- better performance on your CAD applications and your computer hardware. So we're going to show you how to hide points and how to delete points as well.

So let's jump into ReCap. Here is one corner of a building. This was a very large scan. You guys have probably seen this scan before. This is an Autodesk scan that they shared with the community, and we all use it to test our processes out. And for me-- thank goodness-- it was a factory. You got a lot of CNC machines in the corner of this building. Now if I were to put the entire building up on my screen, my computer would start to slow down. So I cropped off one corner of the building. It gave me a big performance increase. So it helps me-- ReCap is a great tool to do that-- to segment your scans so that you can work in just the area you need.

Now the premise here today-- what we need to do-- we need to clear this floor of all this machinery. And then we have new machines that we're going to add to the floor. And we need to figure out where to place those to get the most of the space that we have. That's really the benefit-- or the goal-- of the Factory Design Utilities. But we're going to use a reality capture tool to help us out.

So the first thing I'm going to show you in ReCap is the Limit Box. I always call it the bounding box. I think we all kind of remember that-- but it's called the limit box. And I'm going to edit the limit box-- puts a box around the cloud-- and there's some options here.

One of my favorite options is to highlight my edges. Now all you have to do is drag the box down, and you're hiding the points just by shrinking the box. And I need to get below. There's some HVAC duct work above, and I can actually see that in a highlight. So once I get below those ducts-- I can let go-- and that will give me a good view of the floor.

I'm just going to confirm that. And we just hid a great deal of points. We're talking about millions and millions of points we just unloaded temporarily. So we get production-- or you get a performance increase-- on our system. We haven't deleted them. We just hid them. So the file size is still the same.

Now, when you're talking about cleaning up a scan, it's really about getting rid of the points you don't need. A good example of points I don't need is the floor. I'm going to take this into Inventor in a moment-- and in Inventor and Factory Utilities-- they have a floor. So I don't need all of these millions of points that represent the floor here. I want to get rid of those.

So there's a number of selection tools-- you can come down here. And, you guys, bear with me for a second. And I want to restart my ReCap. I don't know why that's doing that. So real quickly, let me edit my bounding box. I don't know why it's not giving me my floor selection. There we go.

All right-- so-- we're going to go to my floor selection. Now with the floor selection, you simply click points that are on the floor. This helps define the plane-- it's called the planar selection. So I'm just picking points that I know are on the floor. I hit the Enter button. Those points are highlighted. You can actually thicken the floor if you want to. And then you can either click Delete on the screen or I can hit the Delete key. And remove those points that way. So we just deleted a great number of points from the file. File size is getting smaller-- more manageable-- easier for me to use downstream.

Now, I also have other selection techniques available. I'm going to change my orientation. Here's something I always wish I could do in reality. I wish I could come in and turn off perspective mode. With point clouds you can actually turn off perspective and put the world in orthographic view. That is a huge benefit for using reality capture. AutoCAD and Inventor-- and all of our CAD systems-- run primarily in orthographic mode.

There are other selection tools. There's a simple window select. Let's see-- I'm going to get rid of a great deal of stuff here. Here's just a little rectangular window selection. Again, I hit the Delete key and that information at those points are removed. Remember, I want to get rid of all of the data here. I've got some columns here. I need to preserve those. There's a support column right here, so let me save that. And get the data over here. And I'm going through this pretty quickly, but you can obviously do a lot better if you have time.

There's also a fence tool. So sometimes a rectangle doesn't cut it. Sometimes you want to

come in and create a customized polygon. So we can come down and kind of create a polygon-- can pan around over here-- Enter and Delete. And let me finish up with just a couple of more windows.

It doesn't take long to clean up your scan. You definitely want to take the time to clean up the scan. For time's sake, I want to move on-- I don't want to spend a lot of time doing this-- but I could. I could really get this nice and clean before I move on.

Now I also need to adjust my origin-- my coordinate system. To do that, I'm going to go over here to the Point option and select Update Origin. This one's already set up for me, but if usually, your origin is out in space somewhere. So what you can do-- when you update the origin-- you can come in and select the point. I'm going to pick a point right down here-- usually it's a known point in the corner-- usually it's the corner of the building, or a known spot on the site.

So I'm going to click a point and I'm going to hit the Tab button. Just like in AutoCAD, You have a tooltip that tells you-- kind of prompts you through the process. If I click the Tab button, you can select points to orient your axis. You orient the z-axis first, by clicking points. If I zoom out-- picking more points-- so the average of those points will affect the direction of the z-axis. When you like what you see, you hit Enter.

Now I'm going to select the coordinates-- or the points-- to line up the x-axis. So I happen to know, back here on this back wall, there's some points right over here-- that really do line up the x-axis pretty well. I want to check it from the top view and make sure that it lines up with the wall very nicely. And if you want to change the direction of the x-axis, that's the Alt button. The Alt button will change the direction. But once you get the coordinate system the way you like it, you hit the Enter button-- and have taken the coordinate system, and put it exactly in the scan where you want it.

All right. If I go back to my limit box, I'm going to reset it. So now I have all of the points in the overhead back in place. We're getting ready to export, to send this over to Inventor. And in Inventor, you might want to toggle the overhead on and off. So with ReCap you can set that up ahead of time. Just with a simple window pick, I'm going to select all the points in the overhead. Thank goodness for the orthographic view-- makes that selection very easy.

And we have what are called, Scan Regions. I can come over and click a new region. And I'll

call it, Overhead. Just give it a name. If I called it layers, you guys would understand what it is, but they're called Scan Regions. Click OK and those points are in place. And then over here in the navigator. You can come in now-- and turn on the visibility, or turn off the visibility-- of those points, any time you want to.

You can make as many scan Regions as you like. Maybe the machines are a region. Maybe the architectural parts are a region, and the overhead cranes, or the HVACs are different regions. You can use the same techniques to divide your cloud up any way you want.

Now, we finish up by exporting our scan. I will say export-- you can also just save the scan. If this is all you're ever going to do to this scan, you could just save it. But if you need to preserve the original scan for other people to use, you would export the scan.

You can either export it as an RCP-- a Recap Project-- or an RCS-- a Recap Scan. The scan is a standalone file. The project is two files-- the project and the scan-- holds both of those. The regions-- if you want to use the regions inside of Inventor or AutoCAD-- you need to export as a ReCap project. If you just want to use the scan by itself-- with no hidden regions-- just export as an RCS.

Now, I already have this. Just let me reiterate a couple of things. We showed you the orientation of the cloud. We showed you deleting points with the planar method. Orthographic mode-- we showed you how to use orthographic view for your viewing. The fences and the windows for selections. And then finally-- again, in the handouts-- exporting to an RCP or an RCS file.

Now, we want to bring this into Inventor. So inside of Inventor-- I've got my Inventor application up-- and I am using the Factory Design Utilities. Some of you who have just upgraded to the new Product Design Collection-- might be the first time that you now have access to the Factory Design Utilities. You might not have implemented that or installed it-- but there are a lot of advantages to having them. So maybe next year that will be a class I teach, is, Factory Design Utilities for Inventor users. I don't know-- something like that.

So when you start with the Factory Design Utilities-- this is an assembly, that's all it is-- but factories have a floor. The planars object you see-- that's the floor. That's the floor I want to use. That's why I got rid of the points in ReCap. The point clouds-- the Factory Design Utilities were one of the first tools in the Inventor family that could bring in point clouds. I remember-- before Inventor could do it-- the Factory Utilities were primed and ready, and already doing it.

So I'm going to select Attach. And I'm going to go down and select-- I've got this bottom left clean file. It's not the same one I was using, but I just have one ready to go. Now I'm going to bring this in. With the point cloud, the temptation is for you to click and try to drop it perfectly in place. Don't do that. Just click and drop it off. And then there's an option here to insert at the origin. That lines up the origin from ReCap to Inventor. So, see the red axis and the green axis on the floor? That's the origin point. And the cloud lands perfectly where it was supposed to land.

Because the scans in ReCap are always full scale, typically your laser scans are always full scale. We don't have to worry about scale. One to one-- If it's an official, nice laser scanner-- it scans it at one to one. We don't have to worry about scale. I click OK and the cloud is in place-- ready to go.

So now we are ready to proceed with the design-- putting our assets of our machines in place-- to make the most of the limited space we have in the corner of the building. Now, most of the time when I start any factory layout project-- the point cloud is nice. But I like to have a drawing-- a 2D footprint of the building-- that I can put on the floor, so that I can see where things are and I can measure.

I'm an old-time AutoCAD user. I still love my AutoCAD-- I still use it. And the AutoCAD application is certainly part of the Product Design Collection, and a good, solid member of the Factory Design Utilities. So we use AutoCAD a lot in layout design.

Now, what I want to do now-- is I want to utilize my point cloud again-- to create a 2D drawing of the original location of the machines. I want to convert a point cloud to a drawing. A lot of people here at AU want to do that. It's not an-- easy is not the right word-- it's not a straightforward thing to do, because reality and your AutoCAD system are never going to line up.

Does everybody understand? Look at these nice, straight walls. If I were going to draw these walls in AutoCAD, wouldn't you think you'd use a line? But in reality, that's not a line. It's a bunch of splines and curves, and depends on-- up near the roof-- it's different. The walls are actually leaning over-- you can't tell-- but by a small fraction they are.

Hey, reality-- I like to say reality bites-- it really does. It never lines up perfectly with your CAD world. So we want to take a look at a couple of ways to generate drawings of reality-- 2D

cross-sections of our point cloud.

Now last year when I taught this class, I had an app on my iPad that did this. And it was an Autodesk app-- it was called Vectorize It. And if you have that app, don't ever delete it-- because Autodesk discontinued it. This is one of the main reasons I had to rewrite this portion of the class.

2D footprints are-- just-- it's a necessary part of the design process. You need them. They're very commonplace. I remember the first time I did this in AutoCAD, where I wanted to model right on top of the drawing. Put the 2D drawing down and model right on top of it-- so I know everything lines up. You still do the same thing with Inventor.

So I need to get my scan-- what I call, ultra-clean. All right? I need to get rid of everything that's not a vertical member in the room. All of the cords, and the overhead ceiling, and anything else that is not part of the footprint that I want-- I need to delete that. So in ReCap-- actually, I have a video to show you this. I also need a measurement. We'll talk about that in a moment.

And then, one of the tools I'm going to use-- kind of new for many of us, actually-- is a very old tool. It's been around for a long time. It's called Raster Design. Anybody here used Raster Design in the past? Way back when-- when we used to draw pencil and ink-- what you could do, is you could scan your pencil and ink drawings, and create images-- TIFF files. When you could import those into AutoCAD as a black and white-- a bi-tonal image-- and you could edit pencil drawings in AutoCAD with Raster Design. You could convert pencil drawings to Vector drawings with Raster Design.

Well, Raster Design-- it's now part of your AutoCAD applications-- it comes with your applications now. And that's what we're going to do. We're going to create a screen shot from our point cloud cross-section, create an image, bring it into AutoCAD, and trace it with the Raster Design utilities.

Now for this-- just for time's sake-- I got a little video. We're going to look at that one. So I'm going to pull this video open and I'm going to walk you through the process. And this is me doing it-- I did this earlier today.

Inside of ReCap-- I get rid of all the stuff at the top, I get rid of all the stuff at the bottom, I clean everything out-- except for the lines that I want. And they're thicker-- all right? It's deep--

this cross section is very deep-- so that the lines are continuous. I need to take a measurement. What we're going to do-- we're going to have to scale this up and down-- to make sure it's full scale. I need a real-world measurement from the length of this wall in the back. That way I can measure that later on and get this thing back to full scale. So this part's very important. 63 and 1/2 feet is what I have there.

So once I have those two things-- in the new version of Recap-- you can actually change the colors of your objects. Now one of the ways you can change colors by selecting-- you've already seen that-- when you select objects they turn white. And then you can now change your background color in ReCap to black. So this gives me that bi-tonal, black and white version of my design.

Do a screen shot-- you can also print now-- you can also save images with ReCap. So you have an image-- a JPEG or a PNG. You jump into AutoCAD. Start your template file-- I'm just an acad.dwt. And then I activate my Raster tools. Come up to the Raster tools and you can start. The Raster tools, actually, consumes a license. It's a separate license but you have it.

You can bring in the image. So we bring it in-- it's a small image. Now I could rubber sheet this and stretch it if I need to-- but the first thing I do is invert the colors. I put it back to black and white. And then now I can start using my Raster tools to trace the footprint. I'm going to start off by making a quick layer-- just something that's not white-- anything. I called it Lines. I made the color green.

Once I have that done-- on the Raster tools, you have all kinds of tools that help you trace pixels. And I'm going to use kind of an automated one-- it's called a Contour Follower. So with the contour follower-- you simply select a white line, hit the Enter button twice-- and it gets rid of the pixels, and replaces it with a line or a polyline. It's up to you. So now, just put this on fast forward. It's just a matter of going through and clicking the lines, and converting those pixels to Vector data. The walls, the machines-- anything-- you can convert anything you'd like.

Now if you're a Raster expert, I could have gone in and despeckled-- all those little extra points that are floating around-- you could despeckle. You can clean up the image and make it a little bit more linear before you do this. I am really underselling the Raster design tools here.

Now, once you finish tracing it-- or converting it-- you have to scale it back up. So now is when you utilize that measurement-- use the Scale command. I use the Reference option. Pick two points, and then I type in the distance-- the 63 and 1/2 feet-- to make this full scale.

And I think the last thing you do-- you have to move the geometry to the correct point in the UCS. So I need to move the geometry from its current location and put it at 0-0 where I expect it to be. So I just do a quick select with the Move command. I pick the point-- remember the point at the garage door-- and I want to put that point at 0.

So now I've got an AutoCAD tracing. I've converted a point cloud-- with the Raster tools-- to a 2D footprint. Now there is another way to do this-- I think a more modern way. And it has to do with the cross-sections of a point cloud inside of AutoCAD. You can actually cross-section a point cloud in AutoCAD. And they don't automatically generate polylines where the cloud interferes with the plane.

So let's take a look at that process. I would imagine you would like this one better. If you're an AutoCAD user-- if you've been using AutoCAD for a while-- this one will seem more, what you're used to. Here's the ReCap file-- we start with the same ReCap file-- we've cleaned it up. And we export this, and we bring it into AutoCAD.

When it's in AutoCAD-- if you select a point cloud in AutoCAD-- you get a context menu for all the point cloud commands. We're going to section the top. And in AutoCAD-- let me pause this right here. You can make a slice-- instead of a single section plane-- you can make a thick slice. The thicker your plane is, the more points are going to be used to generate your polylines. That's why I took a big swath through the point cloud-- initially-- so that I'd have more points inside of AutoCAD to do this next process.

Now, you have to section the polyline first. You've got to do that. Then you can click the cloud and you can go use the next command-- which is the Section Lines. This is the default setting. You could tweak this-- but when you start this, it will calculate it-- and it traces all your lines automatically. Very nice-- very efficient way to do it. It's already full-scale because we took it right from the cloud.

The last thing I do here is I select the geometry and change the elevation. I want to drop the elevation of those polylines to 0-- so that I've got my footprint in AutoCAD ready to go. So there's many different ways to do this. Now I will be honest. This is all nice-- but just about everybody, will eventually have to go in and manually trace the point cloud. In most cases, if you want to be very specific-- and have a line horizontal for that wall, vertical for the wall, or a rectangle for the machine-- you're going to have to do that manually.

The footprints that I just created are a great starting point for me to go in with the rectangle command, or the polyline command, and make those vertical lines-- color them and create different layers, and so on. You still have to trace it manually at some point-- but it can certainly cut down on your process. Yeah?

**AUDIENCE:** Why would we want to trace your walls [INAUDIBLE] the vertical east, west, north, south-- because you're dealing with the reality that the walls are in a field?

**RUSTY BELCHER:** Great question. Because I want my world to conform to CAD. I want to deal with that wall as if it was a line. And I'm going to have to figure out-- I hate to say fudge-- but I'm going to have to figure out how that line works with that reality.

**AUDIENCE:** My clients want us to deal with the imperfectness of their plan, and deal with that--

**RUSTY BELCHER:** There you go. So at that point you just-- don't trace it-- you just use the tools-- the footprints that we just had. I end up keeping both. I end up having both of them, and you'll see later.

So, back in Inventor. Once I have that done-- the Factory Design Utilities-- they have a tool called DWG Overlay. This allows me to bring in my AutoCAD drawing, and put it right inside of the point cloud. So now I've got my AutoCAD geometry in place. I know where those original machines were. I can now reference that when I'm dropping in the new models-- onto this footprint.

All right-- just mentioned accuracy and laser scans. You need to know the accuracy of your scan. If you have a very impressive $100,000, $200,000, phase-based laser scanner-- you're probably scanning at-- we're talking millimeters of accuracy-- hopefully 1, 1 and 1/2 millimeters within a given distance. You will know that.

If you are out there with your cell phone and snapping a bunch of pictures-- trying to do a photogrammetry scan-- it's not going to be very accurate. You might be within a half of an inch if you're lucky. And there could be major deviations-- we'll talk about later-- based on what you're scanning. So take into account, accuracy.

Remember when I pulled that measurement? That gets to be very critical-- to make sure that the measurement in your scan lines up with the point cloud-- which lines up with your CAD data. Keep that in mind as you work through this process. Don't forget about your accuracy.

Now, next topic is really a factory-centric topic. Now I want to lay out the assets. I want to drop

my models-- my 3D models-- in context of the world that we just set up. I want to lay out the facility. This is where the Factory Design Utilities come into play. So, let's see. I'm going to do the little, baker-and-the-cake demo here. I'm going to close this file. And I'm going to open up another one. So I've got a lot of this done already-- so time-wise-- I'm going to delete a couple of these here.

If you're new for Factory Design Suite-- I'll say this-- how many of you guys use Inventor? Anybody here use Inventor? All right. How about AutoCAD-- how many of you guys are AutoCAD users? All right. You guys using AutoCAD a lot-- what would you do to me if I tried to take your blocks away from you, and say, you can no longer use blocks inside of AutoCAD? How many of you would pick up a chair and start throwing it up here? No, you're not taking my blocks away-- because blocks are fundamental to the AutoCAD process. I don't want to draw the stuff every single time. I want to draw it once, and then drop it in place over and over again.

Well my Inventor users-- how do blocks work inside of Inventor? Well Inventor doesn't really have blocks-- does it? The Factory Design Utilities basically bring the 3D-block versions of our workflows to Inventor. I call them assets-- the asset browser here. You can create any model you want, and then drag and drop it into your file whenever you need it. You can have massive libraries of assets, and usually an asset is a 3D model. That's how it usually works.

So the Factory Design Utilities come with thousands of pre-drawn assets. You can take any model you have, currently-- whether it's an AutoCAD model, a SolidWorks model, a Inventor model, hopefully-- and you can convert those to assets. And when I say assets-- if you're an AutoCAD user-- you can think block. It's exactly how I think of it.

I have a favorite category here, and I basically have one of my Haas CNC machines here. So I need to place my asset. How many of you are new to 3D? Anybody here? How many of you guys are 3D users? All right-- mostly everybody. I remember learning 3D. It wasn't the funnest couple of months in my life-- but anybody can do what I'm about to show you.

Here's the asset-- I simply drag it into the file. And then I can snap to my AutoCAD geometry-- there's my snap marker. And as soon as I place it, a little reposition triad appears. This allows me to spin it, or move it up and down. And I can land it right where I want it.

So adding these assets into the file is very, very easy to do. The assets automatically land on the floor. So if I want to move them around-- if I want to reposition them and try these little

what-if scenarios-- that's not a problem. So I can move stuff around very freely. I can snap it back to the floor if I need to.

Now there is a great deal of advantage to bringing these assets in context of a reality space. I'm not just bringing these in on the 2D footprint. I'm bringing them in and putting them in the room-- in the reality captured room-- to make sure there's enough clearance in every particular space.

All right. The factory layout process-- the factory layout utilities. They have a number of point cloud tools that are very nice in this particular workflow. Having that cloud there is a great timesaver. Now I'm going to take you through and show you some of the cloud tools that are available in Inventor-- and the factory utilities.

So a couple of them that I really do like-- let's see-- how about the Measure tool? Inside of Inventor, I can go grab a distance. And you'll notice that the distance tool automatically selects planar point clouds. So if I were to tell somebody-- measuring from that edge of the 3D model to this face of the cloud-- that's 118-- right at 119 inches. Do the same thing on the back. From the back, to the back wall-- I can tell you exactly what that distance is. So you can measure to a point cloud-- that's a huge benefit .

Now the cloud plane actually works on its own. Say, for instance, you need a work axis at the corner of the room. You can go to your point cloud tools. We'll talk about the cloud point a little bit later-- but here's the cloud plain. And you can drop a work plane there. I'll drop a work plane here.

And then I'll use the old axis command, right? Where two planes intersect, I have an axis-- so I just dropped an axis that's perfectly in that corner. Now I can measure to that axis if I need to-- to make sure where I'm at in the file. You can also have these work planes show up in the drawing. When you do your documentation, you might need a work plane there that represents that cloud of points. It's a great tool for that.

Here's another one-- this is with an asset. I'm going to go to the asset browser, and I'm going to do a search for a sink. Here's my sink station. So with the Factory Design Utilities-- I have snap types-- and I'm going to turn on Snapping to Cloud. This is a unique feature for the Factory Design Utilities. So when I bring this asset in-- normally assets land on the floor-- but with Snapping to Cloud enabled, I can snap them to the wall.

I can actually put my assets up on a point cloud wall now. And then with the Reposition tool, I can stand these things upright. I find 90 degrees-- I can also just type in 90 degrees if I want to. And then I can-- with the reposition tool-- I can raise and lower it, place it right where I want. So I'm actually dropping a 3D model onto a reality captured wall.

The utilities make that possible. And by the way, that's not possible with raw Inventor. So those utilities add a lot of features that regular Inventor users might want to look into. If you're not a factory designer don't worry. There's still a lot of benefit to having those utilities installed.

Oh goodness sakes-- let's take a look at some other benefits the Factory Design Utilities have. I'm going to open up Navisworks. So let me get my Navisworks started here. I got a little laptop up here. Typically, I don't like to run all my applications at once-- but I'm going to do it for this class.

So while Navisworks is loading, I want to take a look at clash detection. This is a big problem. If you're putting new, digital designs inside of a reality-captured room-- how are you going to handle interference analysis? Usually interference analysis happens between solid bodies. Once they interfere with each other, you can generate an analysis of that particular process. Navisworks allows you to run a clash detection-- or interference analysis-- between point clouds and solid models.

So inside of Navisworks-- let me open up my assembly-- so I've already imported this. There's actually a single command that will take your Inventor files and send them to Navisworks. It's a factory design utility-- it's called Sync to Navisworks. So this stuff comes in-- do you see the point cloud? And the 3D data goes right over to Navisworks at the same time. Usually when I talk about Navisworks, I'm talking about walking through and visually inspecting the space. That's really the major functionality of Navisworks-- is to step inside of the space and investigate this, before you commit to construction.

Anybody here got Google Cardboard? All right. You can render this to Google Cardboard and put it into-- I'm going to say-- virtual reality. It's a virtual space. It's not a walk-through reality-- it's standing in place and looking around-- looks pretty cool. The point clouds don't go across to that render, but everything else does-- so, pretty nice.

But usually that's-- when people talk about Navisworks-- they're talking about this visualization functionality. But another major benefit here is the clash detection. So with the clash detection tools-- again this is a new feature-- many of you are getting this for the first time with the

Product Design Collection. This is one of the tools they used to make you pay extra for, but now it's part of the Product Design Collection-- which is fantastic.

So in this particular case-- let's see-- I want to do a test. I'm going to test between all of my solid models-- I select those over here. And I select the point cloud as set two. Now this is a clearance test. It's not a volumetric test-- it's a clearance test.

So I want to know if the cloud ever gets within one inch of a solid body. I run the test-- take a second to calculate that. And I immediately get prompted that, yes, it does. Maybe I overlooked that. Maybe I wasn't paying attention when I dropped this off but, yes, that's-- that's really close.

This is probably an electrical service panel or a junction box. Yeah, I don't want my-- $200,000 Haas Mill-- I don't want the arm to swing over and bump into the junction box. So I need to fix that. When would you like to find this out? When do you want to discover this mistake? Do you want to discover it now while it's a digital prototype? Or, do you want to discover it during construction-- after you've drilled the anchor bolts into the concrete slab, and you're putting the machine in place-- and somebody says, hey, this doesn't look right. What are we going to do?

If you can catch one of these things, now, you just paid for your software. You just paid for your salary for the year, potentially. We're lucky that we just found one. There could have been 50 or 60 in this setup.

You can save the clashes as a report-- put them out to the community so that everyone can address the one they're responsible for. Again, for time's sake, I'm not going to jump into all of that-- but there's a big advantage to having the point cloud and the digital data, together, in the same space. You certainly want to take advantage of that.

Now, I'm going to close Navisworks. Later on, if you have questions, I can bring that stuff back up if we need to. So I've mentioned the point clouds and the Factory Design Utilities-- that there are several tools that are unique to those. I have some more to share with you in the next section. So I want to go ahead and move on.

Now my favorite topic-- point clouds as assets. I remember-- and in all honesty, I remember-- I have had a chance to work with Autodesk directly-- the project manager. When the Factory Design Suite was introduced, I got a chance to write the training manual for Factory Design

Suite. And I remember-- I think it was year two of the Factory Design Suite-- they introduced point clouds.

And of course, you just saw the main demo for point clouds in the Factory Design Utilities. Everyone wants to bring in the building and put your assets in context of reality. But during the meeting I asked the question, what happens if we scan a machine? We should be able to scan a machine, bring it in as a point cloud, and just use it as an asset. We don't have to model anything. If I have the machine already, I don't want to spend a week-- modeling it and putting it into Inventor-- so I can use it as an asset. I just want to scan it, and just use the scan.

So I wrote a paper five years ago, on that, and I gave it to Autodesk. And I'll show you in a moment some of the older assets that we came up with for that process. This process has been around for quite a while. But now with the virtual reality, I mentioned that you're seeing at AU-- you're seeing a lot of people interested in going out and capturing reality, to 3D print it, to take it into your VR, AR programs-- and use those. It now is getting a lot of attention.

Traditionally-- there's no doubt-- that architects and civil designers have been way ahead of us in utilizing laser scans. They've been doing it for years. Just recently has the manufacturing community come on board-- relatively recently. Typically, with a laser scan you're interested in getting walls, windows, doors, ceilings-- all the architectural components. Sometimes a civil component-- the property or something along those lines. You might get that as well.

But now we want to turn the scanners around. Instead of looking outwards at the world, you want to turn them inwards and look at a particular piece of machinery. Anybody see the hand scanners over in the exhibit floor? How many of them did you see? There are all kinds of hand scanners now-- that you can walk around an object and point the scanner into the object-- then to record the shape of a given piece of geometry.

I mentioned the-- it was a Samsung phone-- that has the scanning capability built into the phone already. It's amazing. So it's kind of a different way to look at scanning-- literally turning the scanner around-- pointing it inwards instead of outwards.

What are the benefits of a laser scan asset instead of a 3D solid model? Let's see-- you guys there-- how many of you-- my 3D modelers in the room. You don't have to tell me what you drive at home, but think about your car out in front of your house. If I said, go-- right now-- how long would it take you to model that car?

Listen, don't be giving me the little primitive-- you know-- lines, and the little, very vague-- it looks like a truck. It's about the right size. No-- I want the curves on your hood. I want the fender wells. I want your tool box in the back. I want your-- I want everything.

That's a complex process. And I am not an automotive surface modeling expert-- but I've seen them, I've met them-- and I'm in awe of their capabilities and the tool sets that they use. And I don't have time-- I don't have nearly the time to spend-- modeling my Ford F-150 pickup truck, that has a rusted bumper in the back. I don't have time to do that.

I can, however, go out in my front yard-- take 150 pictures of my truck-- upload them to the cloud. And in two hours I get an email that says, your scan is done. Download it and put it in my CAD system. The time difference is the big benefit here. If you can get away with it-- if you have the machine-- if you can scan it. There's a big if-- got to be careful about that. Just scan it, and use the scan instead of modeling it. In many cases we have the machines. Let's take advantage of the assets we actually own-- and just scan them, and get them into our CAD system.

And of course, many people would scan it-- bring it in-- and model it in context of the scan. That's a legitimate process as well. Point clouds are generally-- generally easier to create than 3D models. It really does depend on what you're talking about. I can probably model the chair in 10 to 15 minutes. So I'm going to make a solid model of the chair. The table-- easy. Some of the equipment in the room-- that's what Inventor's for-- it's great. But really complex objects-- take time. So if we can scan them, can save a lot of time and effort.

So how does this work? If you haven't been there yet, I would encourage you to go to recap360.autodesk.com. Think of it as your homework. You really can't go there on your phone, you can actually go there on your phone, but you can't work with it. It's a PC, workstation based, interface. What you do is you go out, you take your pictures of an object, and you upload your pictures to this website. This is part of your subscription. Hopefully you have a subscription to your Autodesk products. Your subscription comes with what are called Cloud Credits. You get to spend your Cloud Credits here.

Now, let me give you another video tour of the process. So, before AU this year, I scanned my car. That's actually my wife's car, she just bought this one. I took about 150 pictures of the Mini Cooper. From all angles. I had a ladder out my front yard so I could crawl way up high, and then I could crawl way down below, Let me pause here. As part of the process, you have

to take a real world measurement of one of the objects in the scan. You're going to need that to scale this thing later. [? Photogrammatic ?] or photographic conversions are not to scale. You have to be careful. You need a real world measurement. So I measured the diameter of the wheel, wrote that down. Recap360.autodesk.com. This is where you upload your pictures to the cloud. You drop them all in place. You click the next option. You give the file a name. Give the project a name. I'm choosing the five credit option. You can preview this. Let me pause it here. I turn on smart cropping. You're only going to get so many points. And I don't want to scan the entire world. I don't want to scan my neighbor's house, And my deck, and my house. What smart cropping does is it gets rid of all of that and it focuses on the center of the photographs. As long as you're pointing your out your camera at the center of the asset, that's what will be in the scan when you finish. It basically makes your scan more points for the scan. Smart textures.

I'm not into VR, I'm not into AR, yet. But one of these days, I will be. I guarantee, one of these days, we all will be. We'll care about how the textures are applied to the scan. Turn that on now that way I don't have to resubmit later. And then the file types. It asks you what types of files do you want generated. Be honest I clicked them all. Some of you guys mentioned meshes. Instead a point clouds you want a mesh. That's the RCM, the remake file type. So this makes meshes as well as point clouds. Recap scan RCS. If you're into VR, maybe you're into FBX or OBJ. Those are VR file types that the scan and the texture and everything goes with that.

The ortho is amazing. It's a top down, orthographic, picture of the space. Don't have time to dig into that, but those are very nice. Think of what this room would look like, looking down into it, in orthographic mode. As an image, be perfect. Very nice feature for that. All of these file types are available. So, once you have that set, you click create. You get a little message that says this is going to cost you five credits to compute all of this. About two or three hours later, you'll get an email that your scan is done. You can go right back to the same web site and you can view your scan. The web site has a viewer that lets you see your scan. This is not perfect. If I had time I'd show you that my windshield's got a big dent in it. The sunroof looks like it's collapsed, but for 150 pictures in 15 minutes worth of effort, this isn't bad. It looks like a Mini Cooper, it's the right size, it'll work in my downstream processes. So I'm going to use it. I didn't have to adjust this. This is exactly the scan I got, no tweaking.

Here I'm downloading the RCS file, that's the recap scan. Get that on your computer, then you

what? You put it into ReCap. Now you guys are seeing this for the second time. What do you do when you bring it in to ReCap? There is your point cloud. I need to get rid of my points. So I put it into orthographic mode. I add my and my origin. I put my UCS at one of the wheels. So we orient the cloud. I used the wheel to adjust the x-axis. Orthographic mode, and then the window selection to get rid of as many of the points as I need. The more I whittle this down the more effective and the more use it will be downstream. I use the planar selector tool to get rid of the ground. Don't need that. And I use the fence selection tool to get rid of any other bit of the cloud that I thought just didn't look right, or looked ugly. I just want to clean this thing up. You can do any different angle, you can pick your points by adjusting the angle. The orthographic mode is great. I can put this in the orthographic mode and then get up under the car. So I can get rid of the points. The driveway up under the car that showed up, I can get rid of that. And it makes the scan look a lot nicer by getting rid of that data. So there's the finished scan. I exported this as an RCS. There's no hidden data here, so the scan by itself will work. You guys, this is about three times speed.

In Inventor, I bring it in as a new file, new file inside of Inventor. I put the asset into a new file. The UCS, I always check my UCS to make sure it lands where I told it to land. And then here is another cloud tool, the cloud point. I'm going to put some points on the wheel. So, you can put points onto your point cloud, and then you can measure between the two points. This is where that measurement comes in. I calculate a scale factor to scale the data so that it's full scale. I get rid of the points when I'm finished. So now I have a full scale car. I can measure to it to assure that. I adjust my view cube. If you in Inventor user, top, front, left, right, so it works correctly.

And then now is the fun part. Now, you have to draw a Mini Cooper with the sketch tools. Now, trust me, you know the best way to draw a Mini Cooper is to trace a Mini Cooper. Instead of having to go out and figure out the dimensions, I just come in from the orthographic mode I just trace what I have. When you trace, use arcs. I know that maybe you haven't traced in a while, but if you use arcs, it's so much easier to trace these edges. They're almost all natural arcs to begin with. You don't have to be perfect. Make it look good. Honestly, it took about 20 minutes to sketch this out. I just want the sight edges, that's all I want. All right, so I'm going to pause my sketch there. About 20 minutes. Now, with Inventor, once I have these loops, by the way, I just drew half of it, mirrored the other side. Good CAD practice. Once I have that I turn these loops into surfaces.

The surface sits up underneath of the cloud. And this is an important feature if you're going to use this as an asset. I'll show you in a minute. With the factory design utilities, allows me to put a work point. I can use my work point as my insertion point. You guys remember the block methodology I mentioned before. If you've all made a block, you know that you have to declare an insertion point. The work point here will be the insertion point for this asset. You define your landing surface. The x-y plane is the landing surface. You can reorient that. You select your work point as your insertion point. Fill out your metadata. The metadata, just like any model, is going to feed all my downstream processes. And then you publish the asset. There's a little trick. Everything I've shown you so far is right out of the factory design book except this part right here. Let me pause this. When you go to publish your asset you're going to need to tell it, what does this look like in 2D? Point clouds will not generate line work inside of Inventor. What you want to do, you want to tell it to use sketch number one. The sketch, that you drew, that's what will be used in AutoCAD and the 2D representations for the asset it uses the sketch that you traced. Every place else it'll use the point cloud in the surface. You save it in a category. You have as many categories as you'd like. And you now have a factory asset of a Mini Cooper. You can drag this into AutoCAD. Here's the asset browser from the factory design utilities in AutoCAD. So I can drag that in and that that is an AutoCAD block, that's all it is.

And then if I try this in Inventor. Let me show you that, how that works. I'm going to show you that in person, OK. I'm gonna finish up with this one. So, in Inventor. What I'm about to show you, I'm kind of proud of it. I have not, I hope, I hope, you have not seen this anywhere at AU. When I said save the best for last, I hope you guys get excited about what you're about to see. It's kind of been a holy grail for a lot of people to generate drawings from point clouds. So let's take a look at this process, with the factory design utilities, I start a new layout. On my asset browser, I'm going to do a search for point cloud. So, here are all of my point cloud assets. And if you guys bear with me-- Sorry about this I should have done that-- Give me just a second to get onto the internet so I can get all of them. These assets, that I'm using, I have published to the cloud. So if you have the factory design utilities, and you want to go back and try this yourself, if you go to and activate your asset browser you can use all of these. Assets I published them to the world so you can all use them.

Hopefully, I refresh. I can see the internet now, I hope. It's thinking about it. Now, with point cloud selected, if I do the search now I should get some more. So here's all the point cloud assets I've made. So, I'm going to bring in a building. I started off our presentation showing

you you can use the point cloud as a building. I used the same process for this scan that I just went through with you on the Mini Cooper. I took this scan, put it in a file by itself, and I manually traced the footprint, put a surface down here. So I have an asset for the building. Well let's go inside the building and start laying out the space. In a completely separate scan, I have a machine lathe. This is a completely separate laser scan, but I was able to get the machine lathe out of that. So I'm going to start laying out my shop over here. There's the machine lathe. I've got some drill presses. Let's see. So many of these to choose from. Here's my drill press. Let me put two of those in here. Now, I could drop these in exactly where they go, but just for time's sake, I'm just dragging and dropping these in place. Here's a Haas CNC machine. I loved their stuff out on the floor this week. They did a great job. Did you guys get a Fusion key ring? Hopefully you got one of those.

So there's a Haas CNC machine right on the floor, right in place. Didn't have to model that, just took it right out of the scan. Let's see. A couple of years ago, this is an old one, my neighbor got new windows and they parked a cherry picker out in front of my house. And, at first, I was mad. How dare you guys park this thing in my house? Then I thought, I'm going to scan that. So I scan that. This was back in the 123D Catch on my cell phone. This is 50 pictures. And it still holds up, it's still pretty good, not perfect. If I zoom in it looks kind of hideous. But if I zoom out, I recognize that. So this is free. This was a quote unquote free one. Let's see. One of the guys in my office set up the scanner at John Deere. That is a very high end laser scan of a John Deere tractor. $100,000, $200,000 laser scanner used for that one, millimeter precision, works. Let's see. Out back, what can we park? Here's my truck. This was the big one last year for me. This is my pickup truck. And then, this year, my wife's Mini Cooper. Drop it right in. My wife won't let me drive her car. I understand that, I'm a big guy. Actually, you fit very nicely in there. Heated seats, it's really nice. I'm kind of envious of her. But she did let me scan it for the class. So, really appreciative of that.

So, what haven't you seen this year at AU? I hope you haven't seen this. Let me save this assembly. I want you to notice, I haven't modeled anything. No extrusions, no revolves, no sweeps, nothing. All I did is grab laser scans, put a little sketch down on the ground. Inside of Inventor. I'm going to start a new file a DWG file. This is my documentation tool inside of Inventor. Do my base view, the top view, click OK. Boom, done. if I have to document the locations of my machines, I'd go grab my annotation. Maybe from this column to this edge. 3 foot 9. Let's see, from this face to this face. Put that one down there. So, I'm generating all of my installation documents right from the scans. And let's see what else, a couple of things. I'm

not going to delve into too much of this, but for instance the truck. If you have extra lines that you want to make it look pretty. You can actually go in and grab your extra sketch lines. Say get model sketches. This puts extra lines, just makes them look a little nicer. Kind of like having layers if you have different line work that needs to look differently. For instance, the lathe and the drill press have some extra lines now that make them look a little bit more like a lathe that you'd see.

But, let's see, how about a parts list? Anybody seen somebody generate a bill of material from point clouds at AU this year? God, I hope not, because I haven't seen it. Here you go. Here's my here's my balloon for my machine shop we were laying out in the back. I can balloon the building if I want to, or have to. Here's the Haas CNC machine, the tractor, cherry picker, Mini Cooper, the truck. Remember we did two drill presses, right? So, up here by the drill press quantity is two. Inventor's been able to do this for years, but now I can do it with point clouds. And, if you've ever seen somebody give an Inventor presentation, this is how they all end up. They'll all, once to get the drawing done, they'll go back to the assembly and change something. It's really important that your documentation updates automatically if you make a change to the design. So, let's zoom in here. Now, I'm going to turn off snap to point cloud, that gets in the way. But I'm going to bring in my generator. Here's another old scan I did. This is the generator down in my garage. I'm going to put it in the truck bed. Now that's down on the ground, right? I can use the reposition tool, pick it up, put it in the truck bed so that it looks correct. You guys read the license plate there? That's my truck, [? RUSTYB ?] By the way, I got rid of my wife's license plate. These little rectangle window selection tool. Got rid of the numbers. Right? Get rid of the data that you don't want to share. I add something to the design, I go back over to my drawing, bang. Already sitting in there, ready to go. Drop in the balloon, and you'll notice it's already in the bill of materials.

So I just did an entire layout, a simple one, but proof of concept at least. An entire layout inside of Inventor. The best, honestly, best 3D modeling application Autodesk makes right now. I still will hold on to that. I have Inventor on my t-shirt, so I'm going to stick with that. And I didn't model anything. I just used laser scans the whole way. I think the process is efficient and you guys, I've got a lot of scans lined up. I don't have time to do it, but I've started to grab some very high end toy cars of a Porsche. For some reason, I go down to the Porsche dealership, they won't let me scan a Porsche. They won't let me get near it. Well, I can go get a model of one. Scale doesn't matter. Scan it, hopefully in a couple of days there'll be a Porsche, and a GTO, and some other cars that I have ready to go.

So, the process works and I hope, what I want, I want you guys to prove it. Prove it to yourself. If you have Inventor, get the factory design utilities installed. Grab your cell phone and go out and prove this for yourself. Real quick, and these are are in the handout for you. When you take your pictures, try to include the entire machine in every picture. Take pictures from all different angles. Upwards of 100 pictures, usually. The max is 150, so you got 150 pictures. Use them to the best you can. Avoid reflection and glare. That's why the windshield on my car kind of collapsed, because it was reflective. My wife didn't want me to go out there and take the little Christmas snow and put all over the windshields, but that's a way to get rid of reflection if you have to. Watch the background, I had a chance to do a forklift once, And the top of the forklift, the truck, was black. And the woods, the forest, around me was all black. So, when I tried to scan it the top of the forklift disappeared into the woods because everything was black. Try to get a good contrast. Use a consistent light source, no flashes. Your light source has to be the same. The shadow needs to stay the same on the ground. You walk around the object. You don't spin the object. You walk around it. Textured surfaces work better than flat surfaces. Try to add some texture if you want to.

Use recap to clean it up. You don't need the floor in that particular case. Bring it into Inventor. The entire process is called out in your documentation. And the video you just saw is on my YouTube page with the Mini Cooper. If you want to step by step video that's rustybelcher1965. Come up and check out that YouTube video. Test it for yourself, and I really do think you will find that this process can augment what you're currently doing. Certainly in the future, I really do expect a lot more of this asset collection, collecting real world objects to get them into other CAD applications. I just see this getting better and better and better. I don't know if you noticed but the scan of the truck, that was last year, this is the scan of the Mini Cooper this year. It's a much better scan in just one year of time. So they're constantly making these tools better. Look for them to get even better into the future.

I will say again, just to reiterate, if you go back, get your factor utilities installed, you have access to all the assets you saw me use today. They're on the cloud. You can bring them down, right click on the asset, download it, and you can use it at your site to prove the process. I've done that work for you. Hopefully you guys can get a chance, if you want your bosses to see it, if you want to share the workflow with other people, you're more than welcome to take that and run with it. Hopefully, you can get in contact with someone in the support community, either Autodesk or your reseller, and maybe they can work with you on this project as well.

So that's what I've got for you guys. I'm going to finish up. I've got about 15 minutes before, if you guys want to head over and get into the final meeting, the final keynote, you're more than welcome to. But take the time, if you can, please take the time and kind of evaluate the class if you haven't got the mobile app yet. If you liked what you saw. But, from this point on, if you guys have any questions, I'll be glad to answer them the best I can. So I appreciate your time. Listen, I thought there would be nobody here today. So, I'm amazed you guys are all here and I hope you guys enjoyed what you saw. Hope you can make use of it, I really do.

So, any questions before we finish up? I'm going to take this microphone off. [INAUDIBLE] recording. Did anybody see anything like that at AU this year? Did anybody see drawings from point clouds? I'm cheating a little bit, you know, I'm laying out the footprint ahead of time. But thank goodness I have that block, or asset-based, workflow that, once I do it once, I can use it over and over again. Any questions before we finish up? Yep.

**AUDIENCE:** I have a pretty simple one for probably people who do Inventor. Trying to match with it at work-- we've worked at a [INAUDIBLE] 663 feet off of a ceiling. How do I raise the floor to that level? [INAUDIBLE]

**RUSTY BELCHER:** So, with the factory design utilities you can adjust the height of the floor. So, whether the floor needs to be 663 feet down or your asset needs to be 663 feet above the floor. When you published the asset, usually, the asset lands on the floor, but there is a factor there you can add that it will float above the floor a given value.

**AUDIENCE:** Is that located in options?

**RUSTY BELCHER:** It's when you publish the asset. When you select the landing surface there is an option. You'll see it a lot. Some of the lights, when you bring in the lights, that float above the floor, they automatically float above the floor. And that can be a parameter. So, if that height changes, you can parametrically change that. So, that's 660 some odd feet, that's pretty deep, but it is possible to do.

**AUDIENCE:** Well, that was just where our nominal floor elevation of the facility. So I'd to see the floor in Inventor at that elevation so I can land on it.

**RUSTY BELCHER:** Yes when you start a new layout there is an option to drag the floor to a given elevation, yes. You can also have designs with multiple floors. So, if you have multiple floors, just a new

layout for every floor.

**AUDIENCE:** So I would from there out?

**RUSTY BELCHER:** Yep. OK. Any other questions? Well, you guys, that's it. If anybody wants to stay after and ask a question you're more than welcome to. I'll be here for a few more minutes. But thank you guys for coming in. You guys enjoy the rest of your time here. Safe travels getting home. Hopefully we all make it home just fine.

**AUDIENCE:** Likewise, thank you.

**RUSTY BELCHER:** See you guys next time.