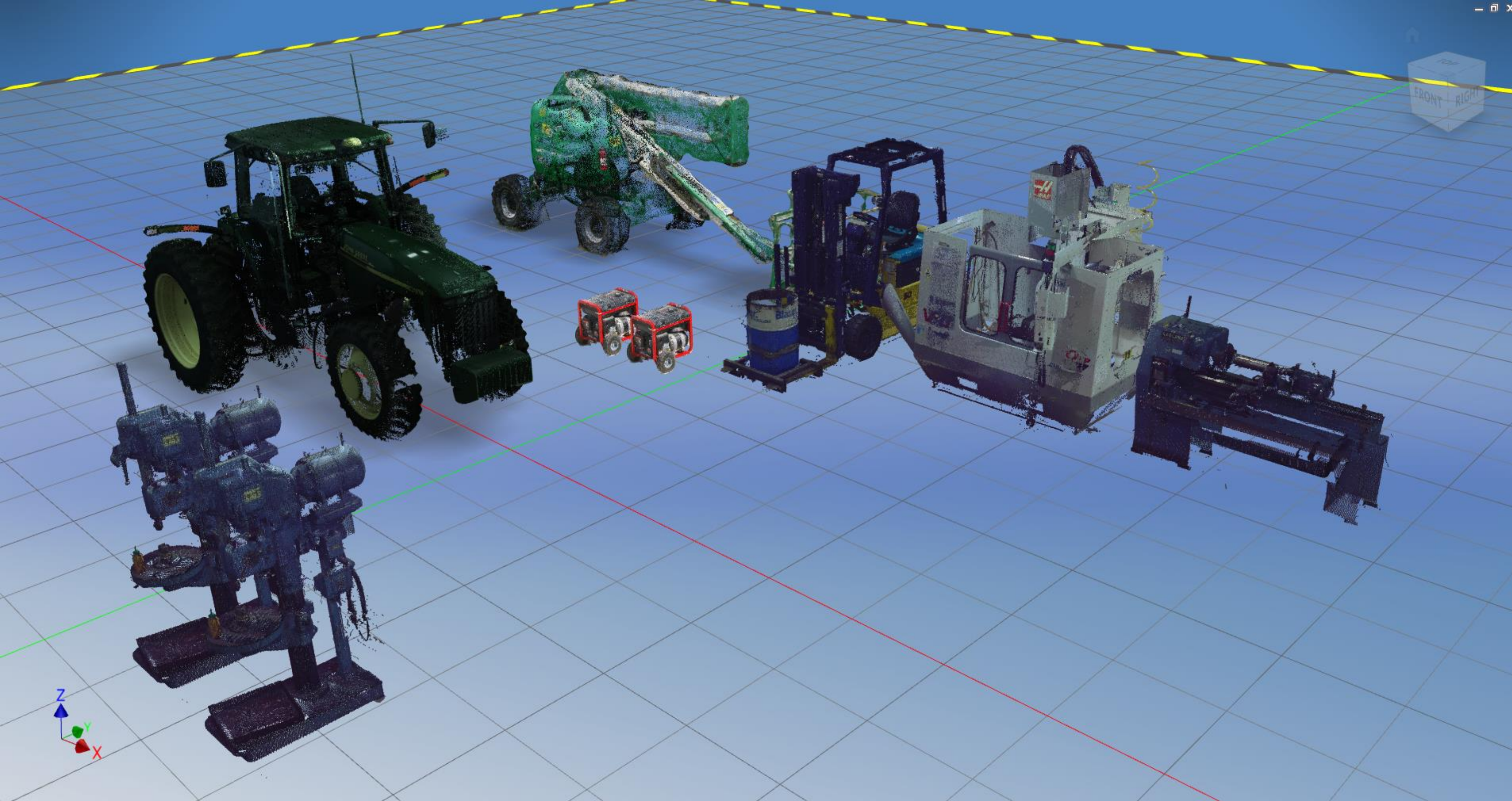


MP20871: Recap and the Factory Design Utilities A Great Combination

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Class summary

Reality capture techniques are becoming commonplace in many aspects of design. The factory layout process is no different. From the clean-up and orientation of the point cloud to the possibility of using point clouds as factory assets, when it comes to utilizing point clouds with Factory Design Suite software, there is a lot to consider. Join us in this class as we focus on the various techniques and workflows for capitalizing on point cloud captures in the factory layout process.

Key learning objectives

At the end of this class, you will be able to:

- Discover techniques to clean up and orient a point cloud with Autodesk ReCap.
- Learn how to create a DWG™ overlay from a point cloud capture using various Autodesk applications.
- Learn how to create your factory layout in context of a point cloud, and how to check for clashes with Autodesk Navisworks.
- Investigate the possibility of using a point cloud as a factory asset.

Clean and Orient your Point Cloud

For use in Downstream Applications

If you want to utilize Point Clouds in Inventor or AutoCAD, you Must use ReCap.



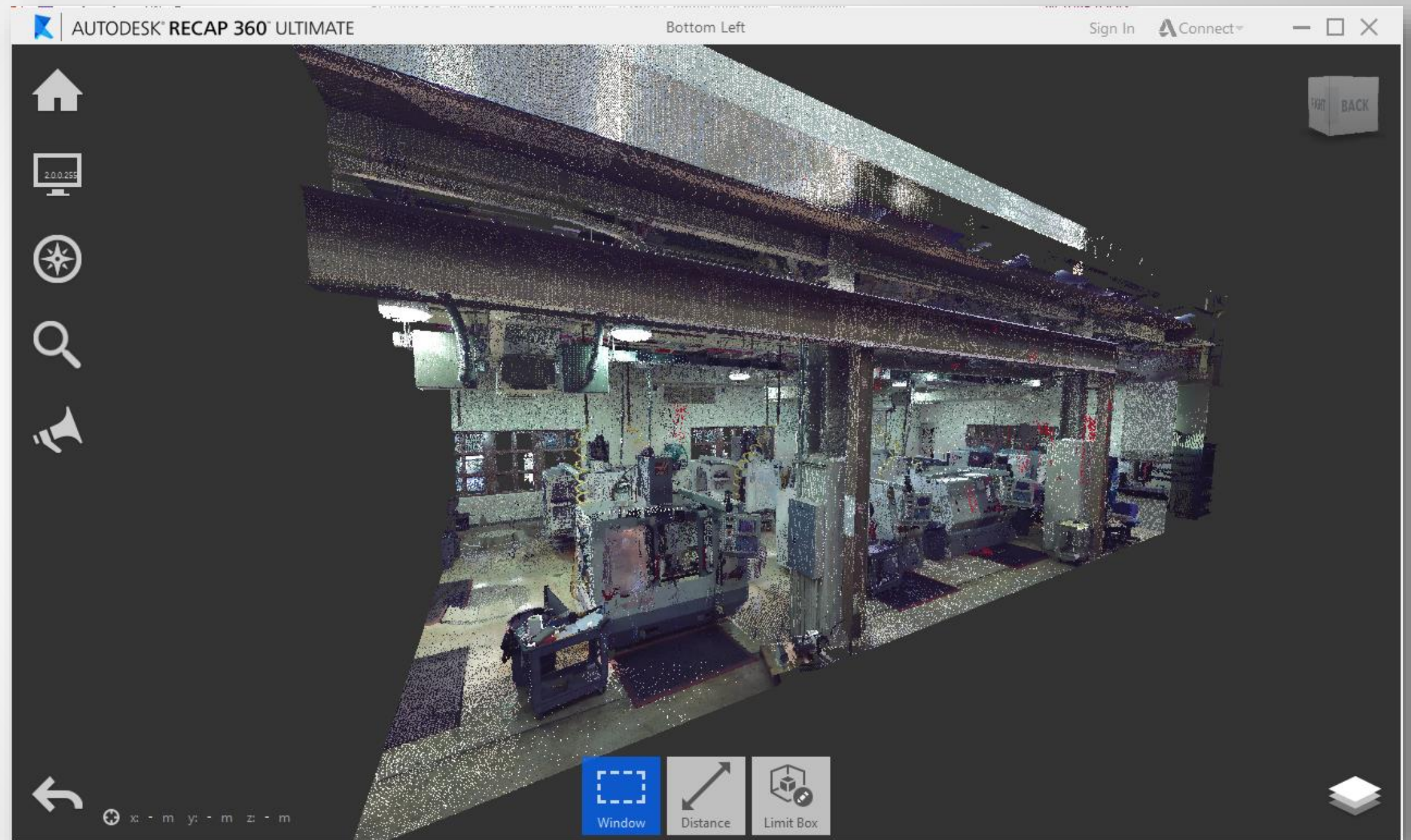
Scan Formats / Factory Design Suite Applications

Laser Scan Formats and Applications in the Factory Design Suite		
Autodesk AutoCAD	Autodesk Inventor	Autodesk Navisworks
Autodesk ReCap (*.rcp, *.rcs)	Autodesk ReCap (*.rcp, *.rcs)	Autodesk ReCap (*.rcp, *.rcs)
		ASCII Laser (*.asc, *.txt)
		Faro (*.fls, *.fws, *.iQscan, *.iQmod, *.iQwsp)
		Leica (*.pts, *.pts)
		Riegl (*.3dd)



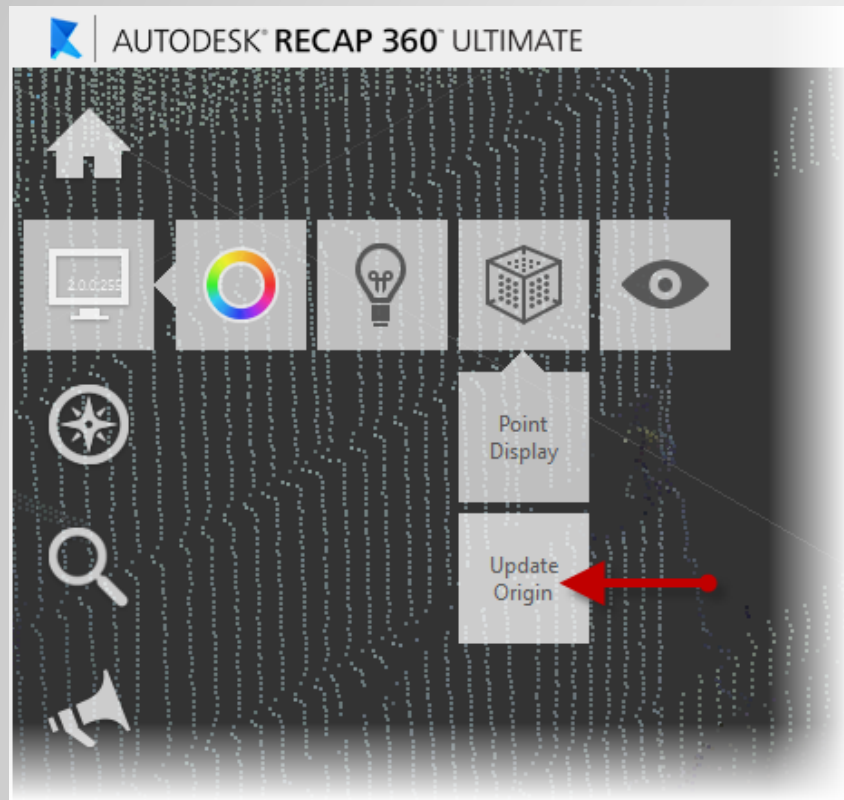
You Must Cleanup your Scan

- A Majority of points are not needed.
- Fewer Points = Better Performance from the CAD applications.
- The X,Y,Z Orientation will not line up with the CAD applications.

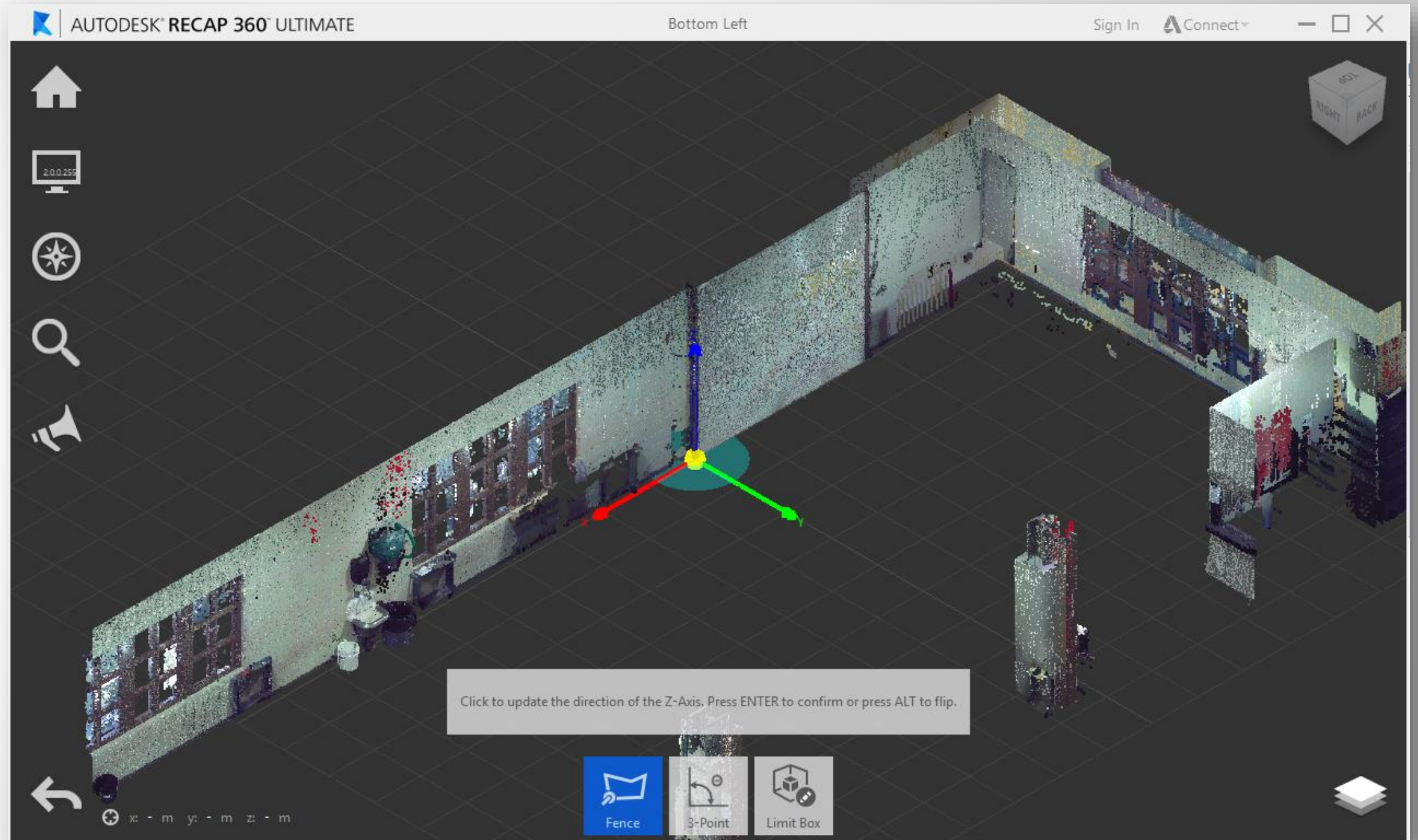


All scans will need some type of cleanup before they are used downstream

Reorient your Point Cloud

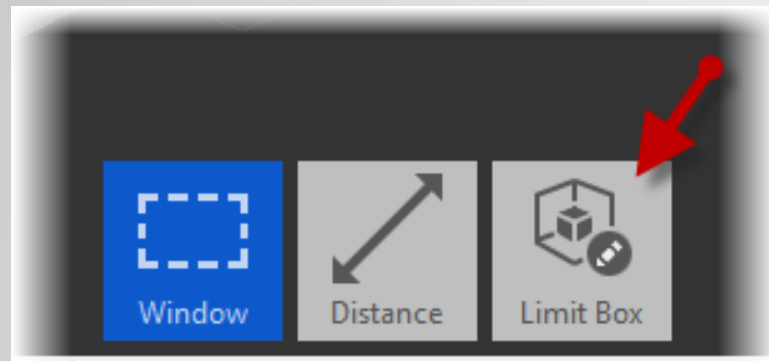


- The Z Axis is usually fine.
- Select a patch of points to define the X axis.

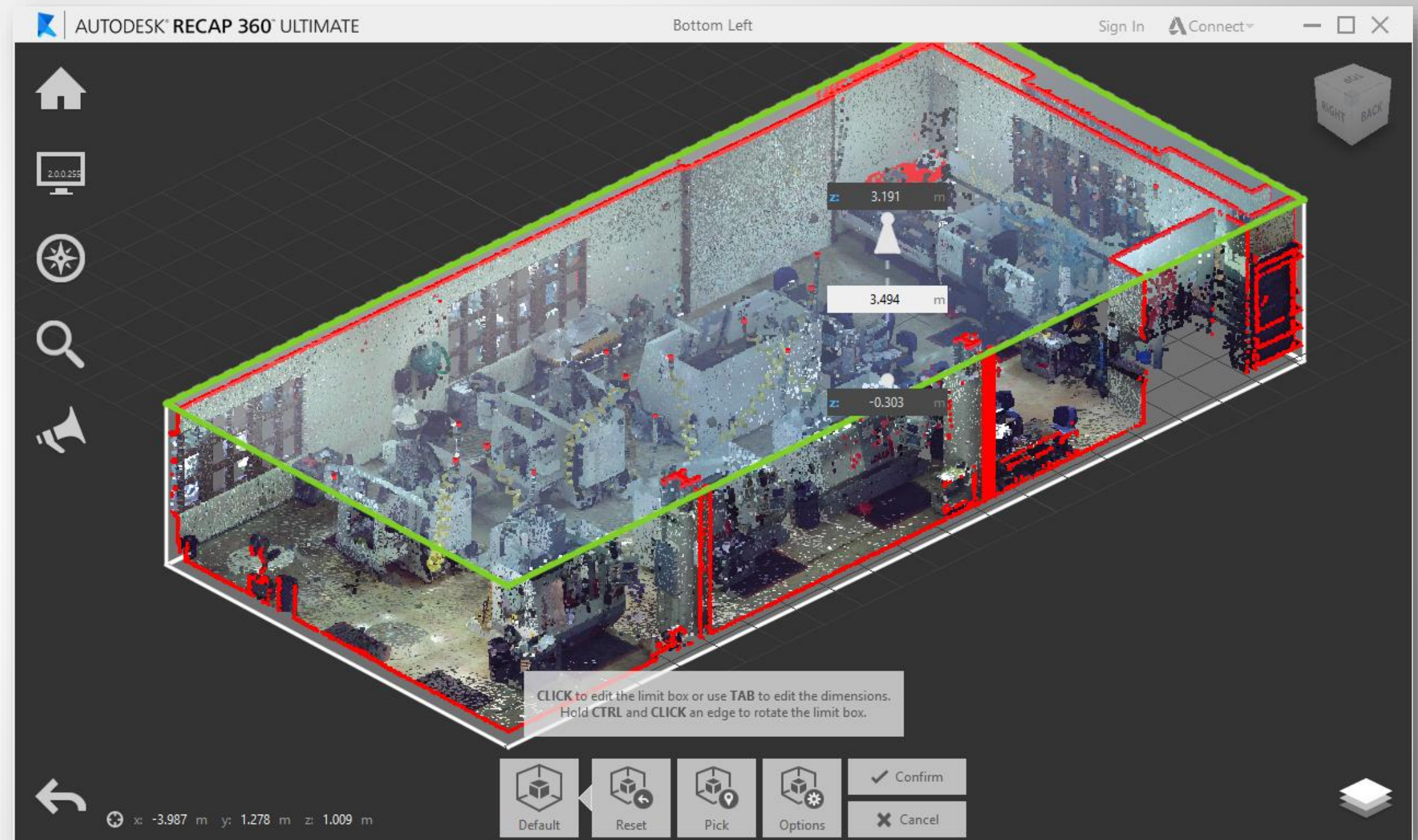


This Orientation will be used in the downstream CAD application.

Hide Points with the Limit Box

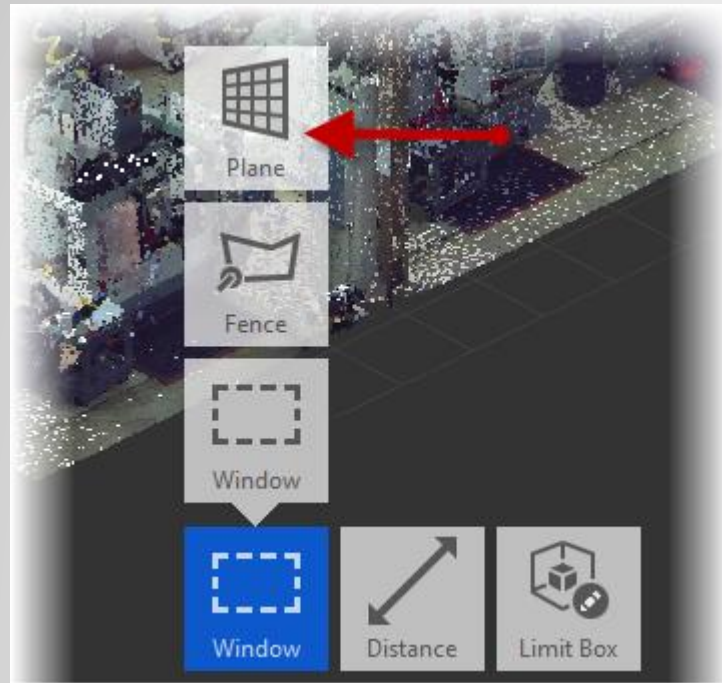


- Points are Hidden not Erased
- Option to Highlight edges.

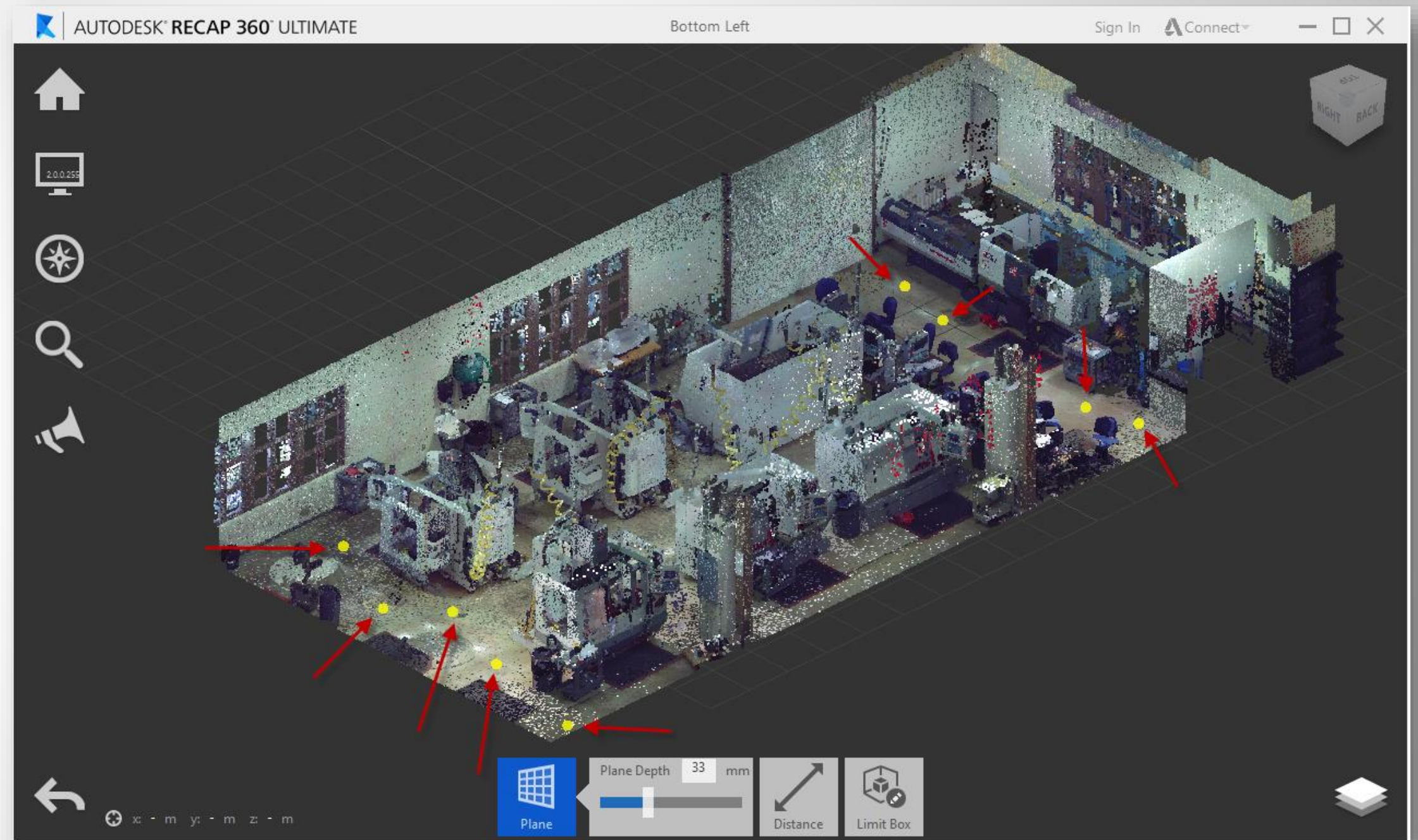


Temporarily remove points to access the interior of the scan.

Delete the Floor Points

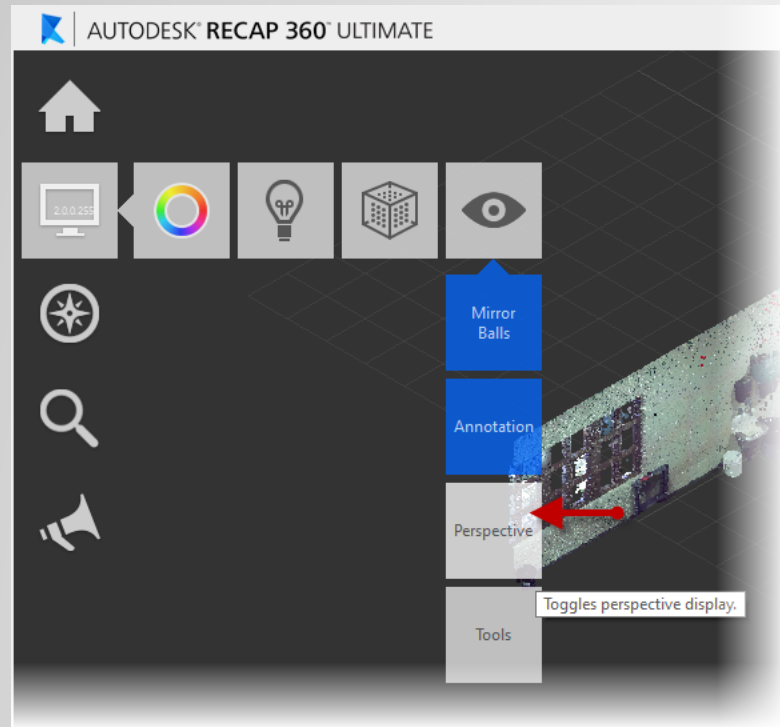


- Floor Points are Erased (Hiding is Optional)
- FDS provides a Floor Plane
- Fewer Points = Better Performance

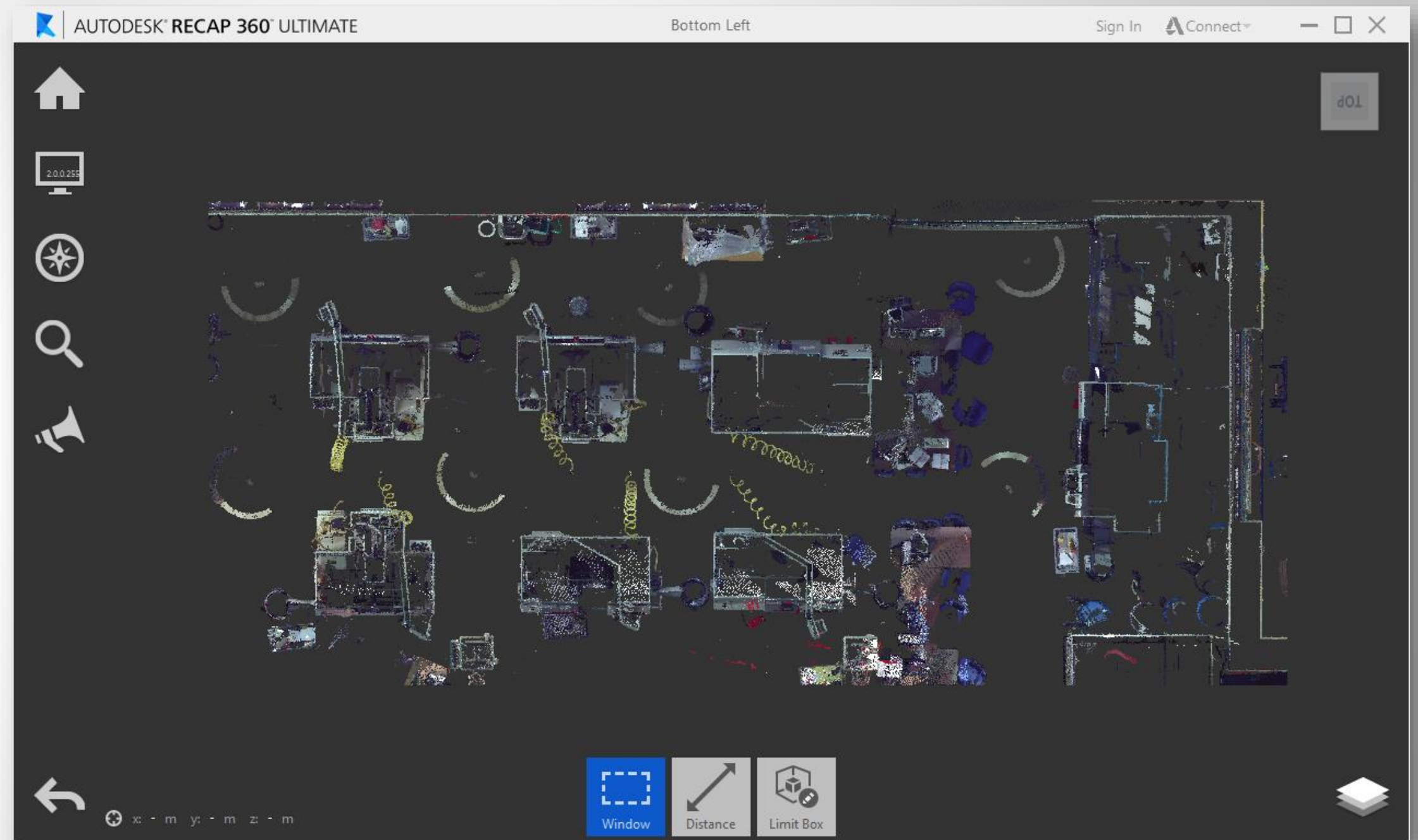


Remove the points that make up the floor.

Perspective / Orthographic Toggle

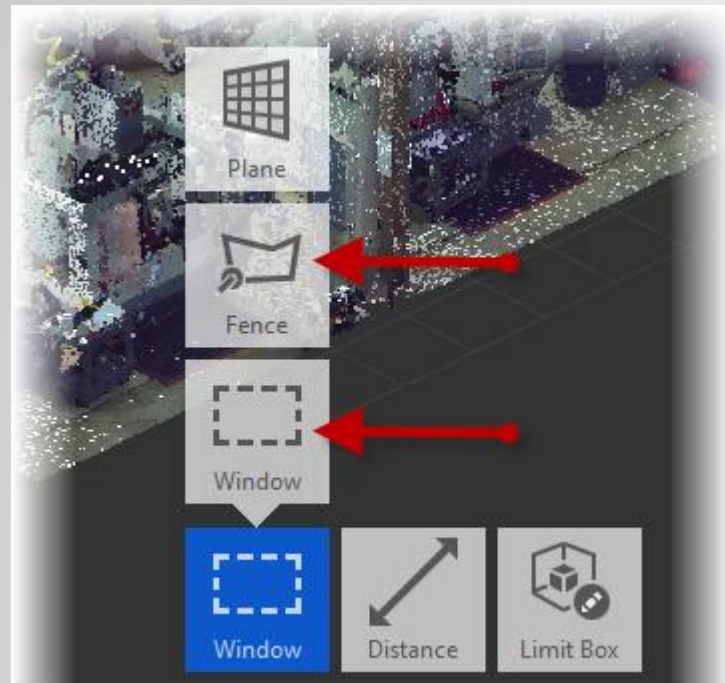


- Easier to clean up remaining points.
- Begin to see the defining “lines” of the space.



View the cloud in orthographic mode

Use Window and Fence Select to Remove Points



- Floor Points are Erased (Hiding is Optional)
- FDS provides a Floor Plane
- Fewer Points = Better Performance

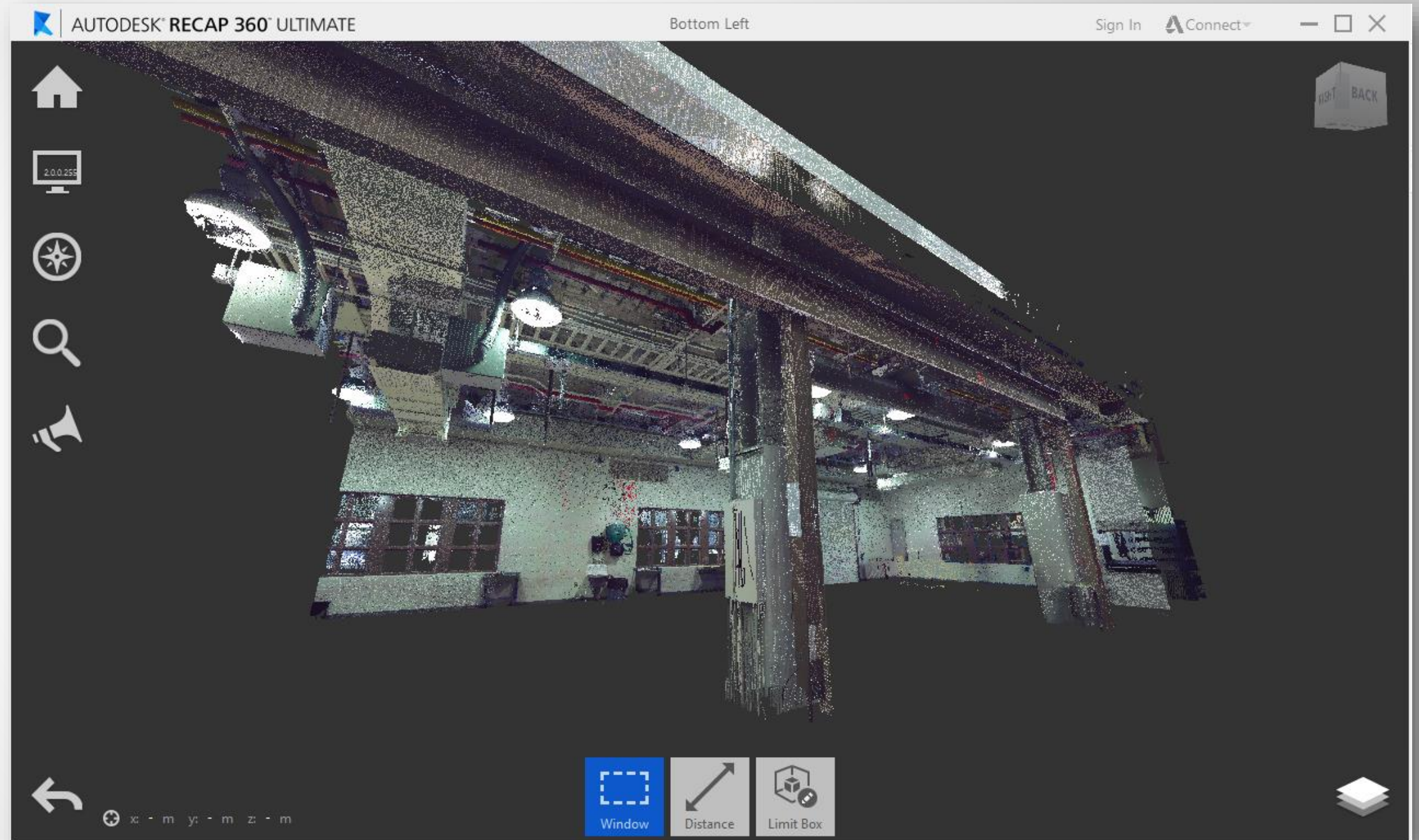


Remove the points that make up the floor.

Export the Scan to RCP / RCS

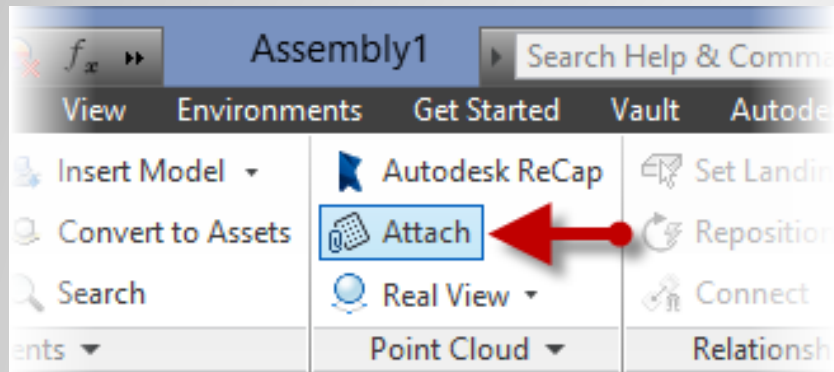


- Reset the Limit Box to unhide points.
- RCP Contains Scan Regions and can reference multiple Scans.
- RCS is a single unified Scan.

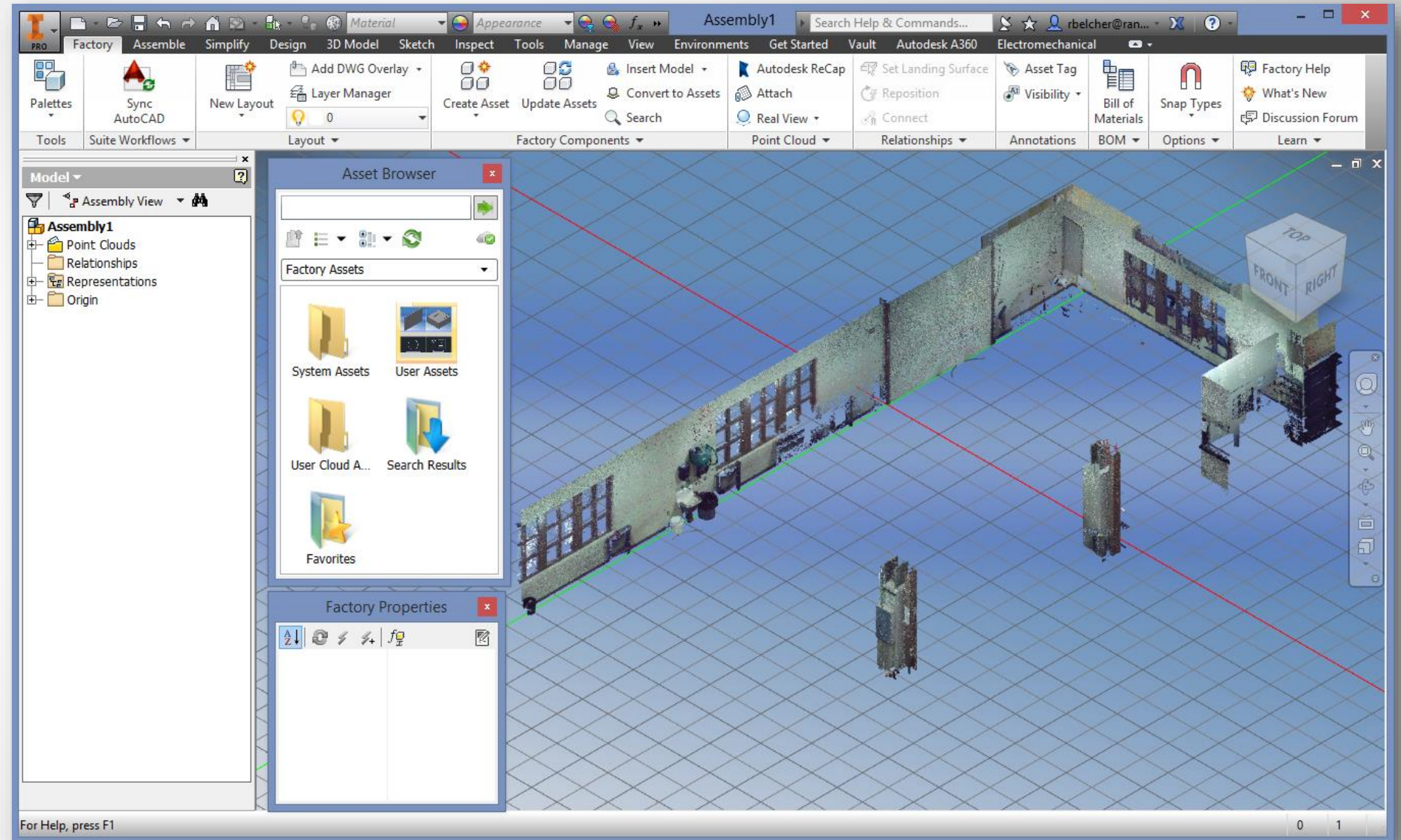


Export the Point Cloud via RCS to Autodesk Inventor.

The Scan Imported into Inventor

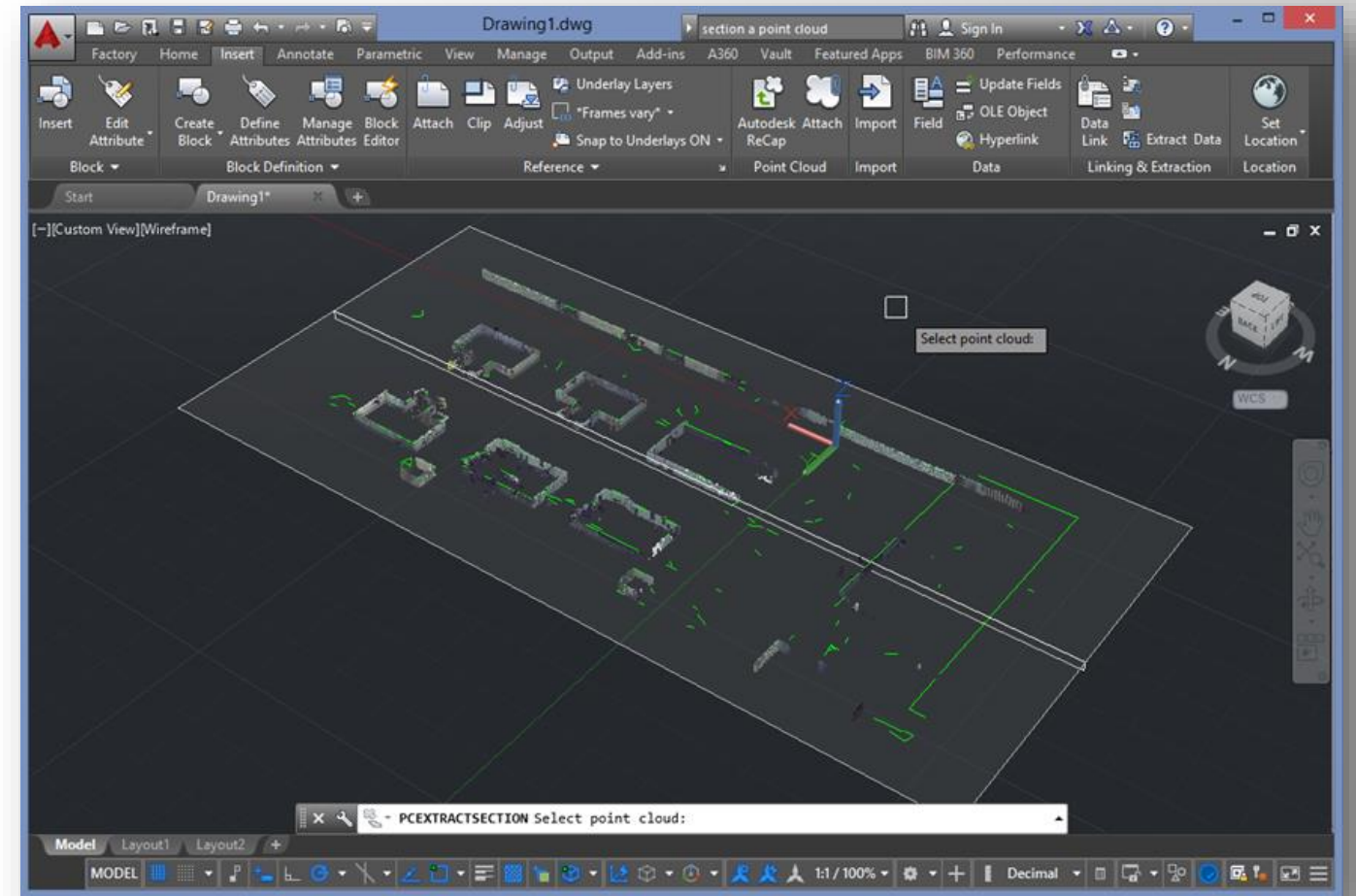


- The Scan is imported into Inventor via .rcs / .rcp.
- The Scan serves as the context for all asset placement.



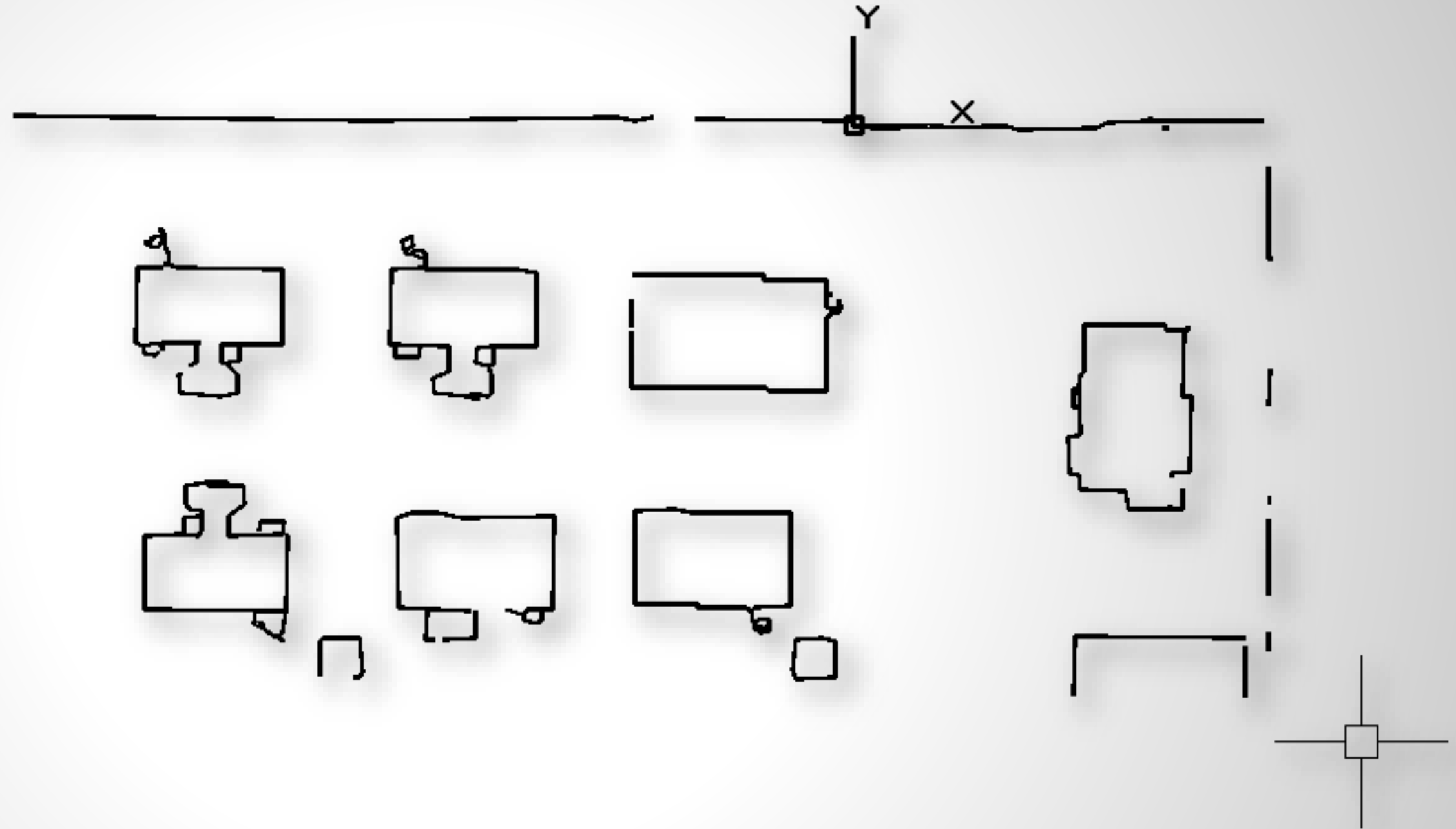
Assets can be placed in context of the actual building.

Creating Drawings from Point Clouds using Autodesk Applications



2D Lines are often Necessary

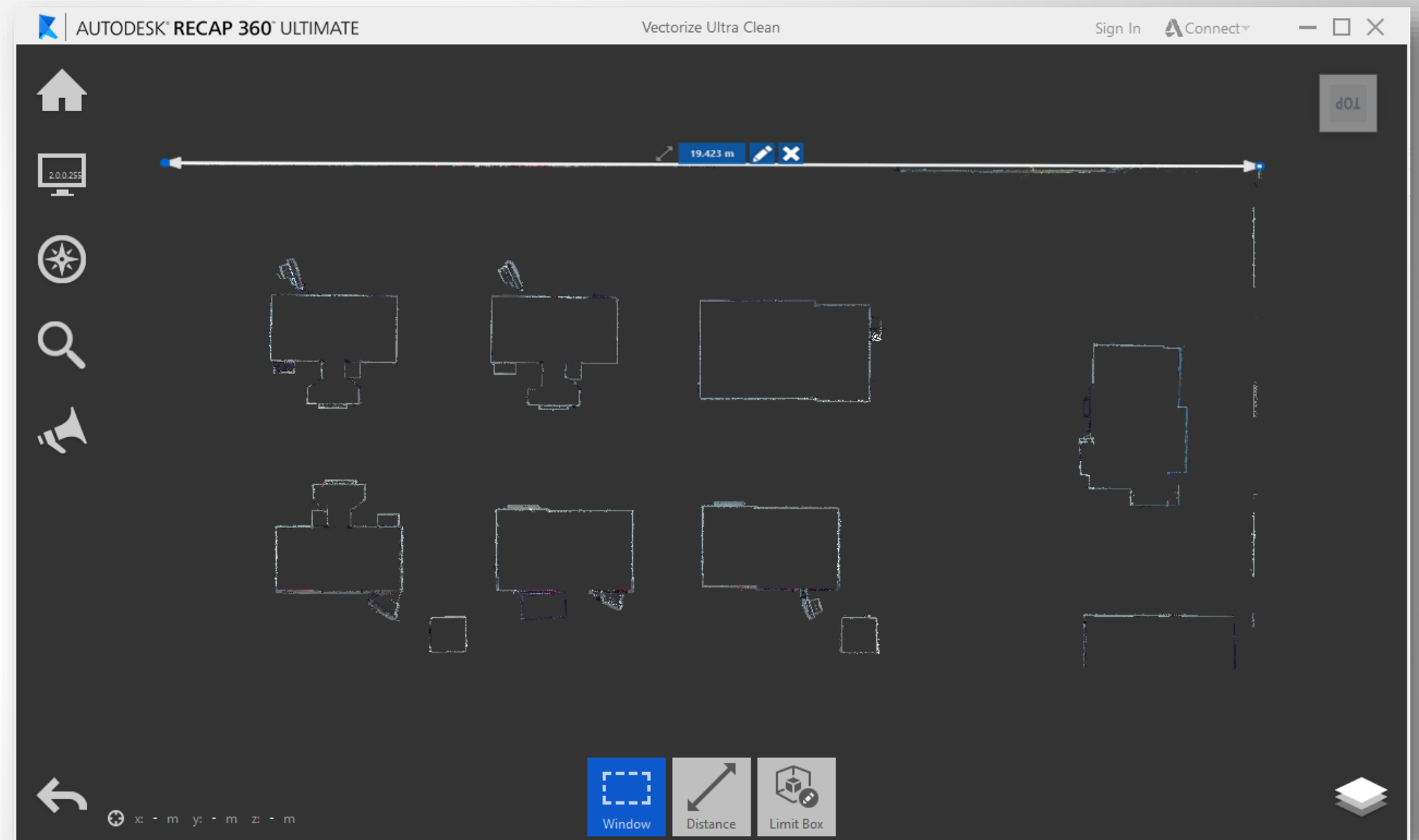
- The generated vector lines will not be perfect.
- The Vector lines will require cleanup
- There are other applications available to extract vector geometry from point clouds.



In most cases you will eventually need to create 2D lines from the scan.

Scan needs to be Ultra Clean

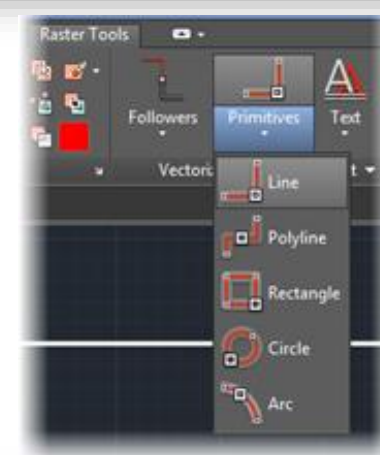
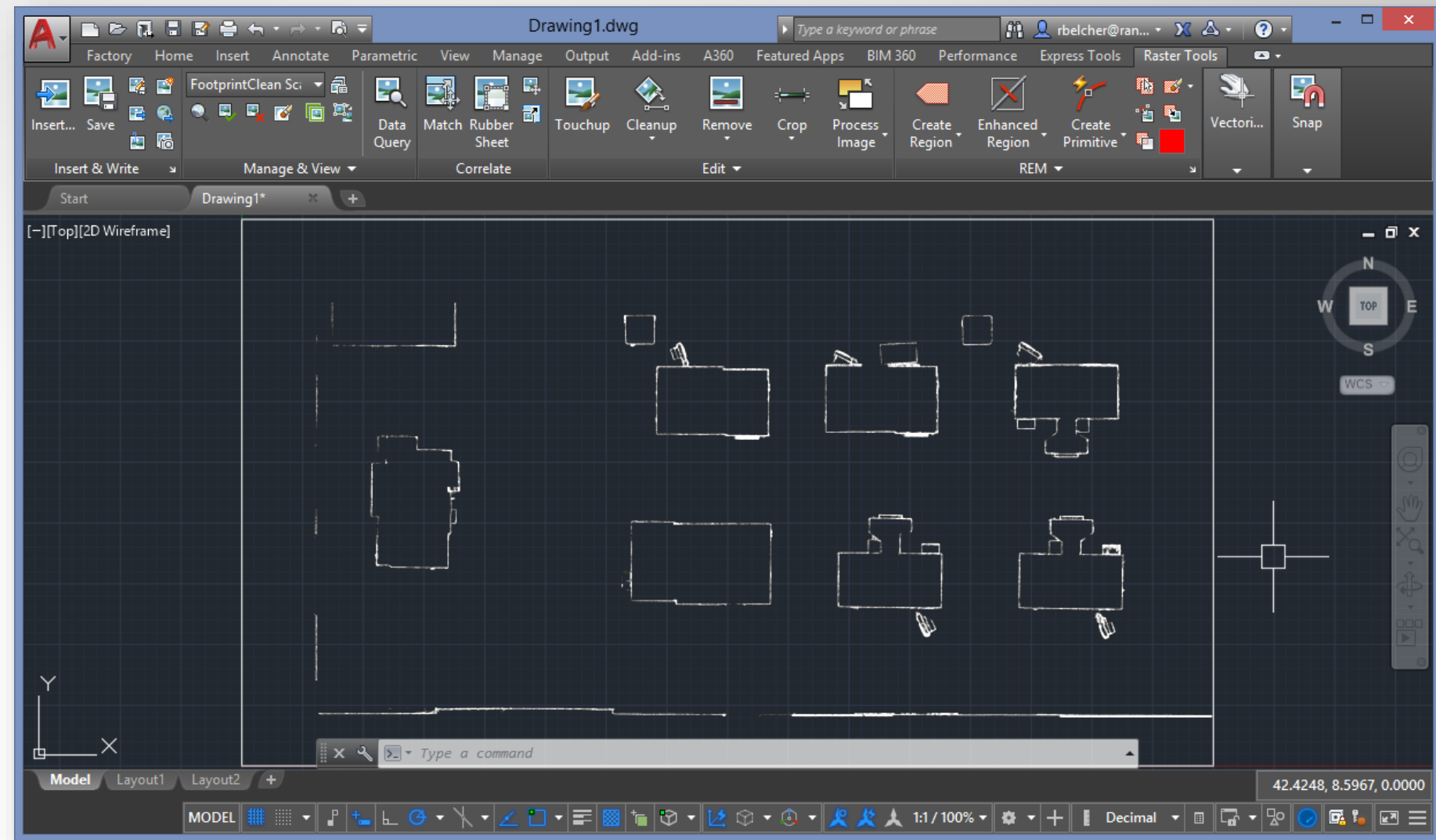
- Remove all points that are not considered lines.
- Use a thicker cross section to make the lines appear continuous.
- Select and highlight the points prior to generating the screenshot.
- Pull a Distance Measurement for the scan. (For Future Use)



Use the selection tools to cleanup the cross section of the cloud.

Raster Design

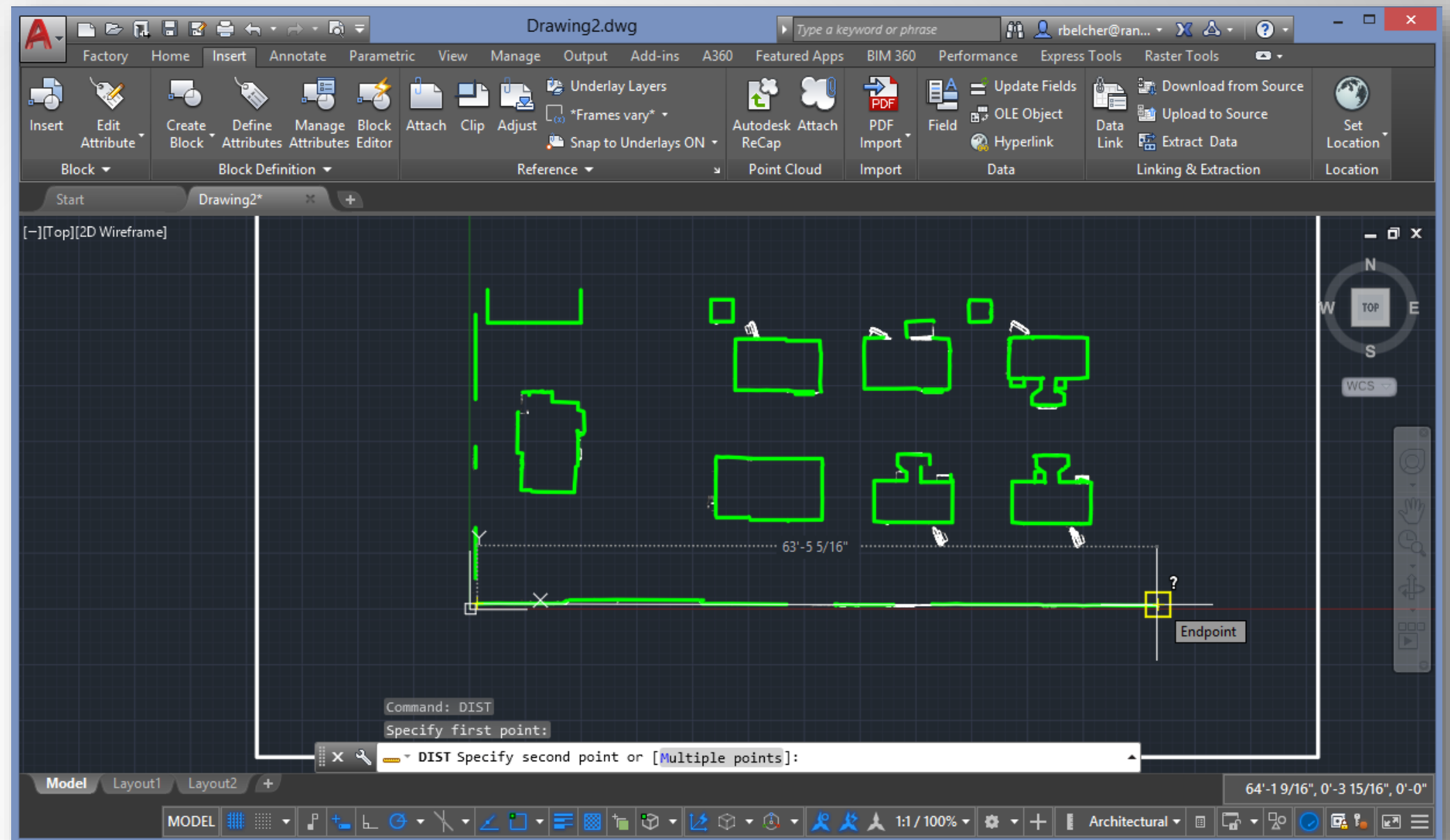
- Adjust the image to Bitonal
- Convert Raster to Vector
- Use Follower and Primitive vector commands



Use Raster Design to convert the screenshot to vector geometry.

Raster Design

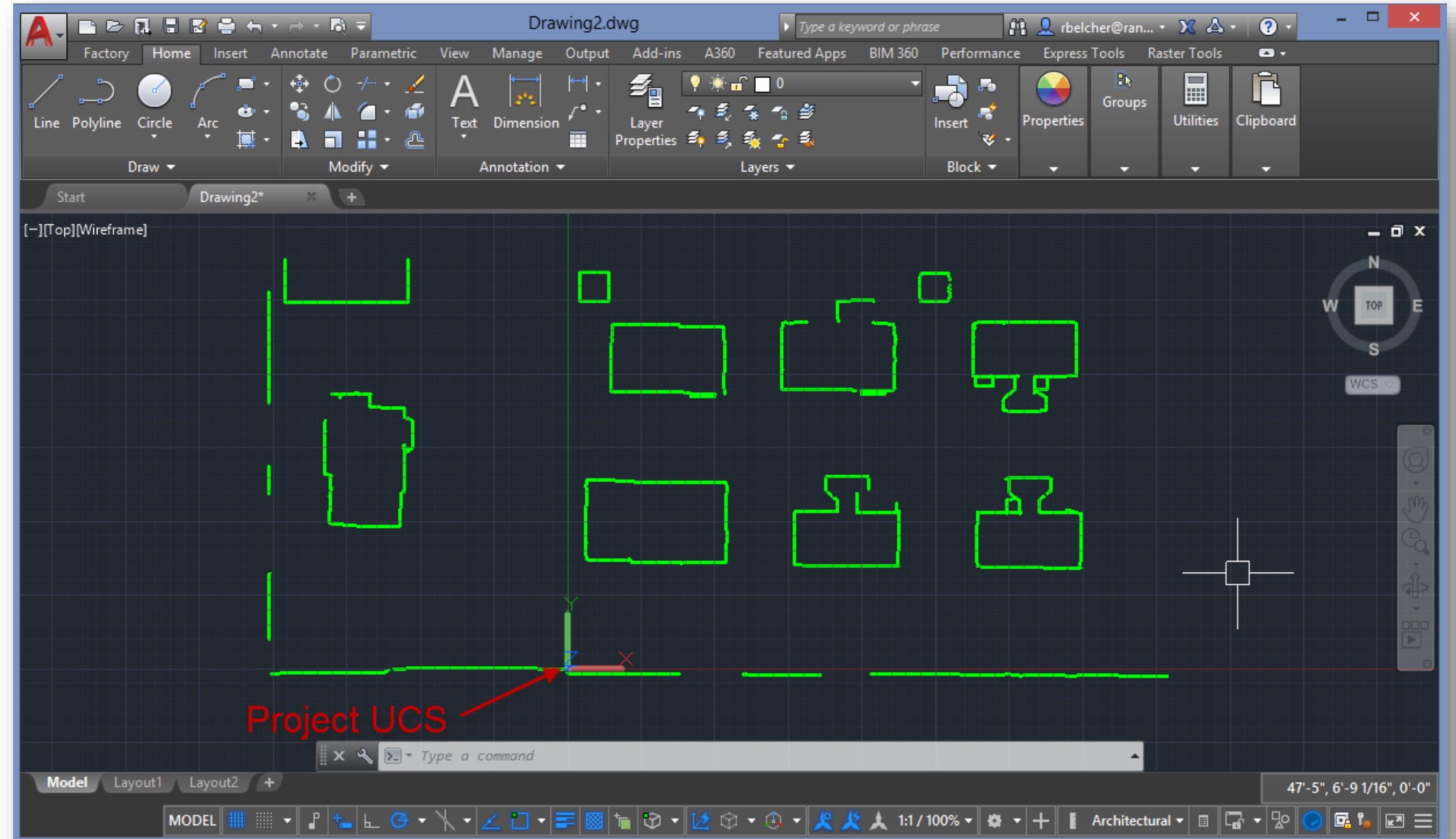
- Use the Dimension option to scale the vector data correctly



Add a dimension value to scale the vector geometry correctly.

Raster Design

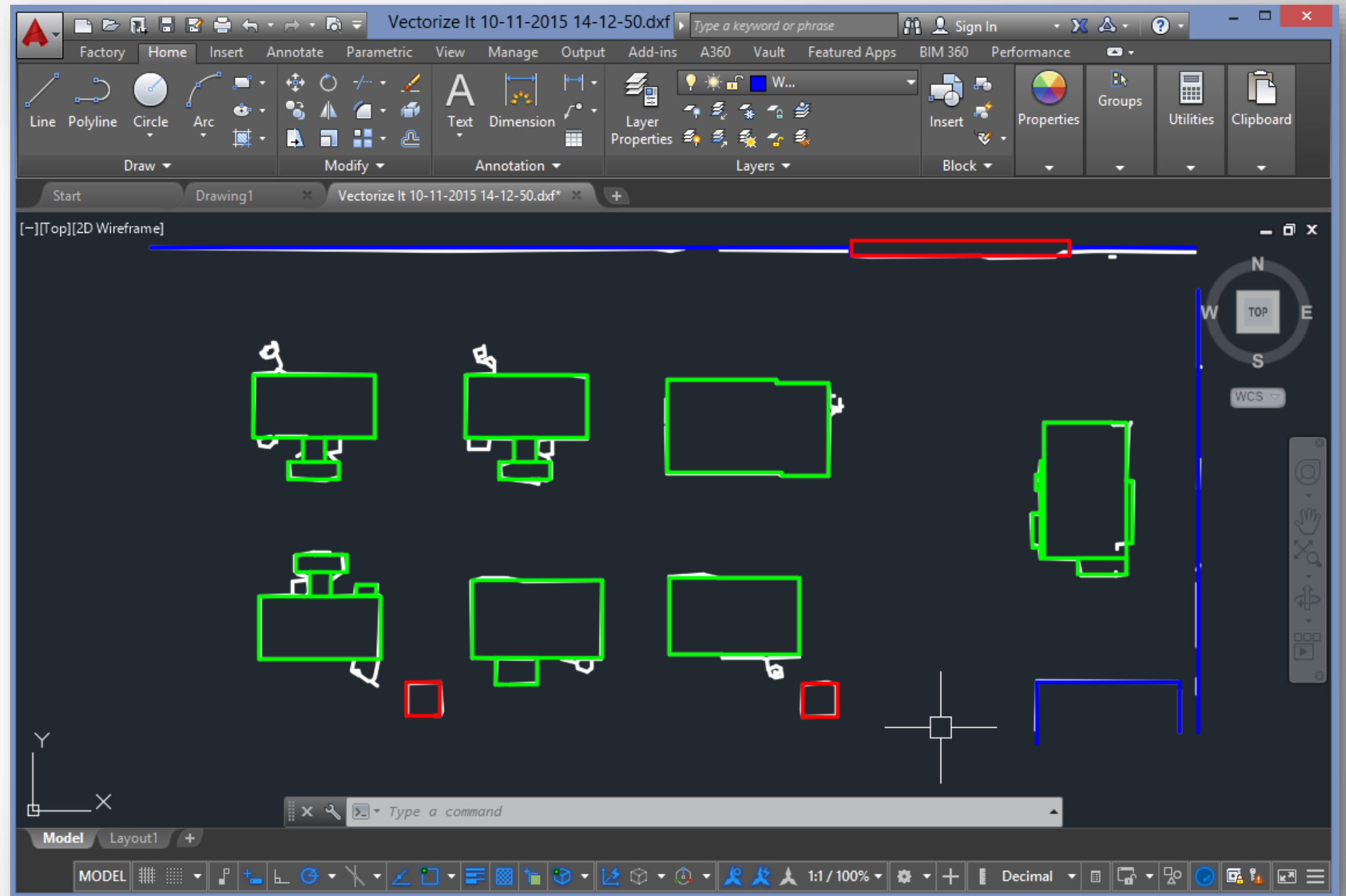
- Orient and Align the footprint to the project coordinate system



Move and Align the footprint to the project coordinate system.

Clean and Scale the .dxf geometry

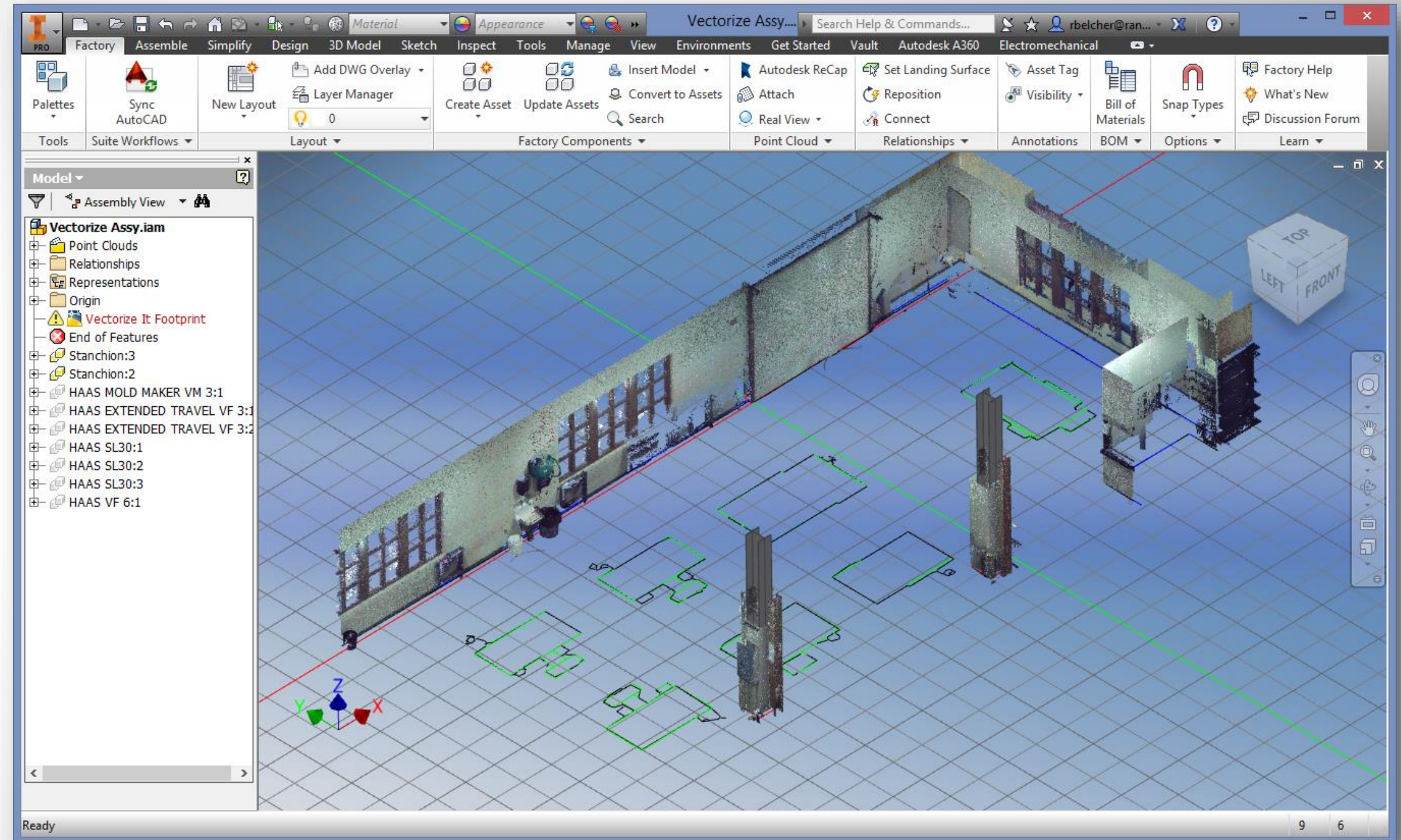
- Use Lines and Polylines to cleanup or overwrite the vector geometry.
- Use Layers as Necessary.
- Preserve the vector geometry for reference.



Prepare the drawing for use as a DWG overlay.

DWG Overlay from a Point Cloud

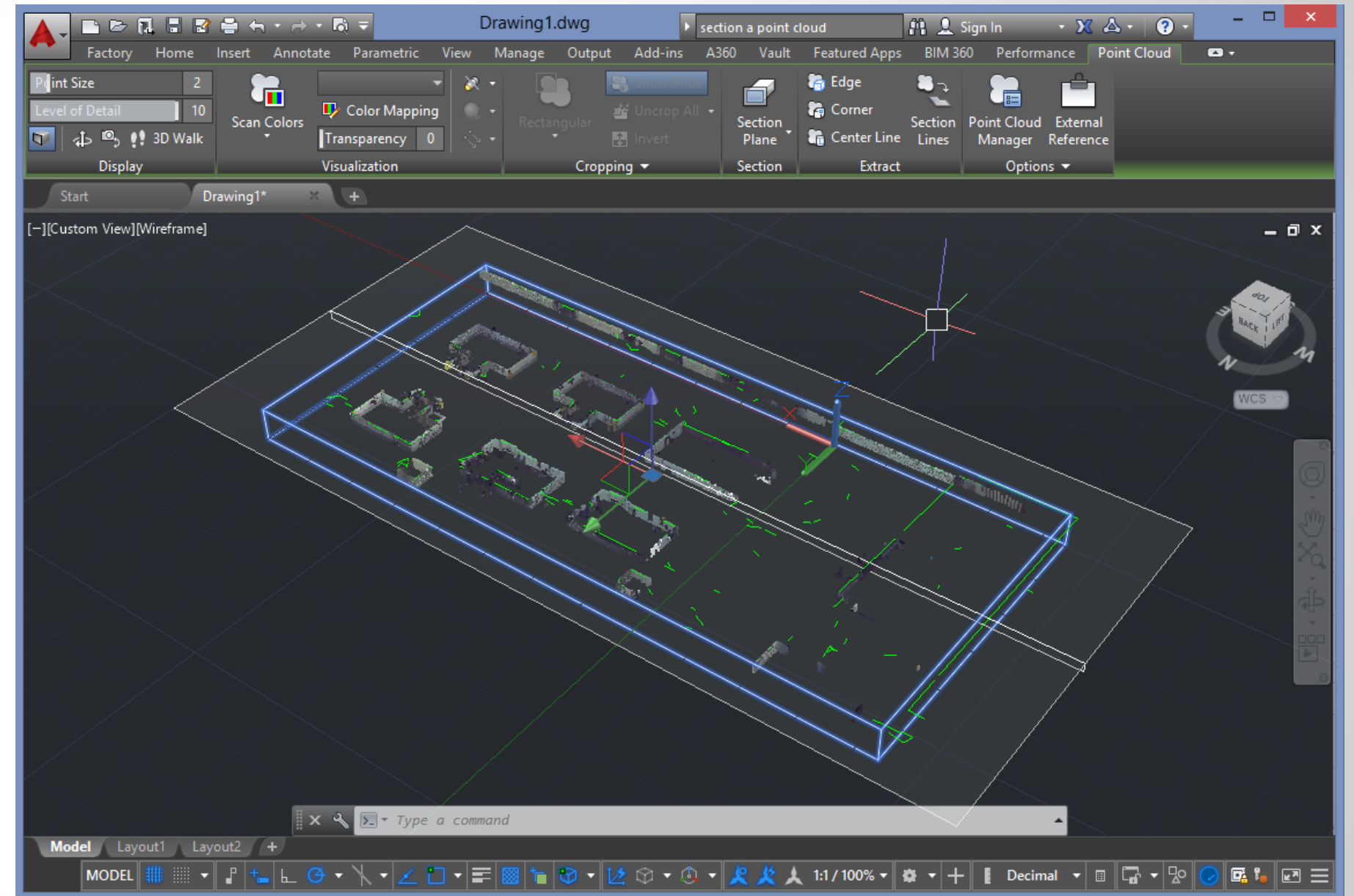
- Use the new drawing a DWG overlay in FDS.
- Add the original Point Cloud as well.
- Assets can be snapped to the DWG overlay



The extracted section lines are used as a DWG overlay in FDS.

Other Methods for Extracting Vector Geometry from Point Clouds

- Extract Section Lines
- Extract Corner
- Extract Edge
- Extract Centerline
- Commands based on point analysis
- Cleanup is still required



AutoCAD offers a number of geometry extraction tools for Point Clouds.

Accuracy

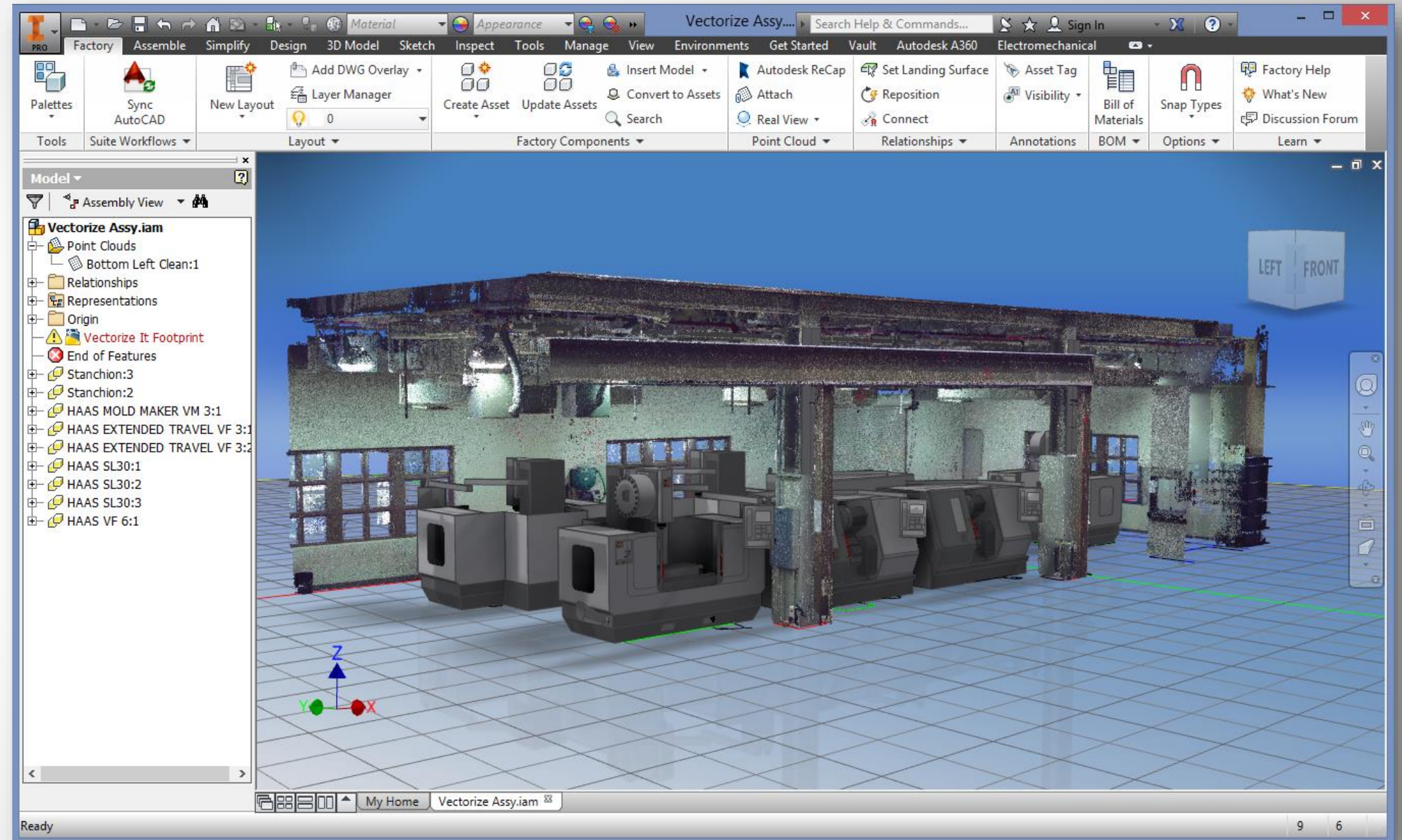
Whichever method you utilize to extract section lines from a point cloud, please remember the accuracy of your final drawing will not be exact. If you utilize the Raster Design approach, the process of scaling your drawing based on the ReCap dimension does require some human analysis and interaction. The human aspect of this process will diminish the overall accuracy of the final drawing. But, when it comes to facility layout, location tolerances can be relatively large and this process should work just fine.



Creating a Factory Layout in Context of a Point Cloud

Factory Layout in Inventor

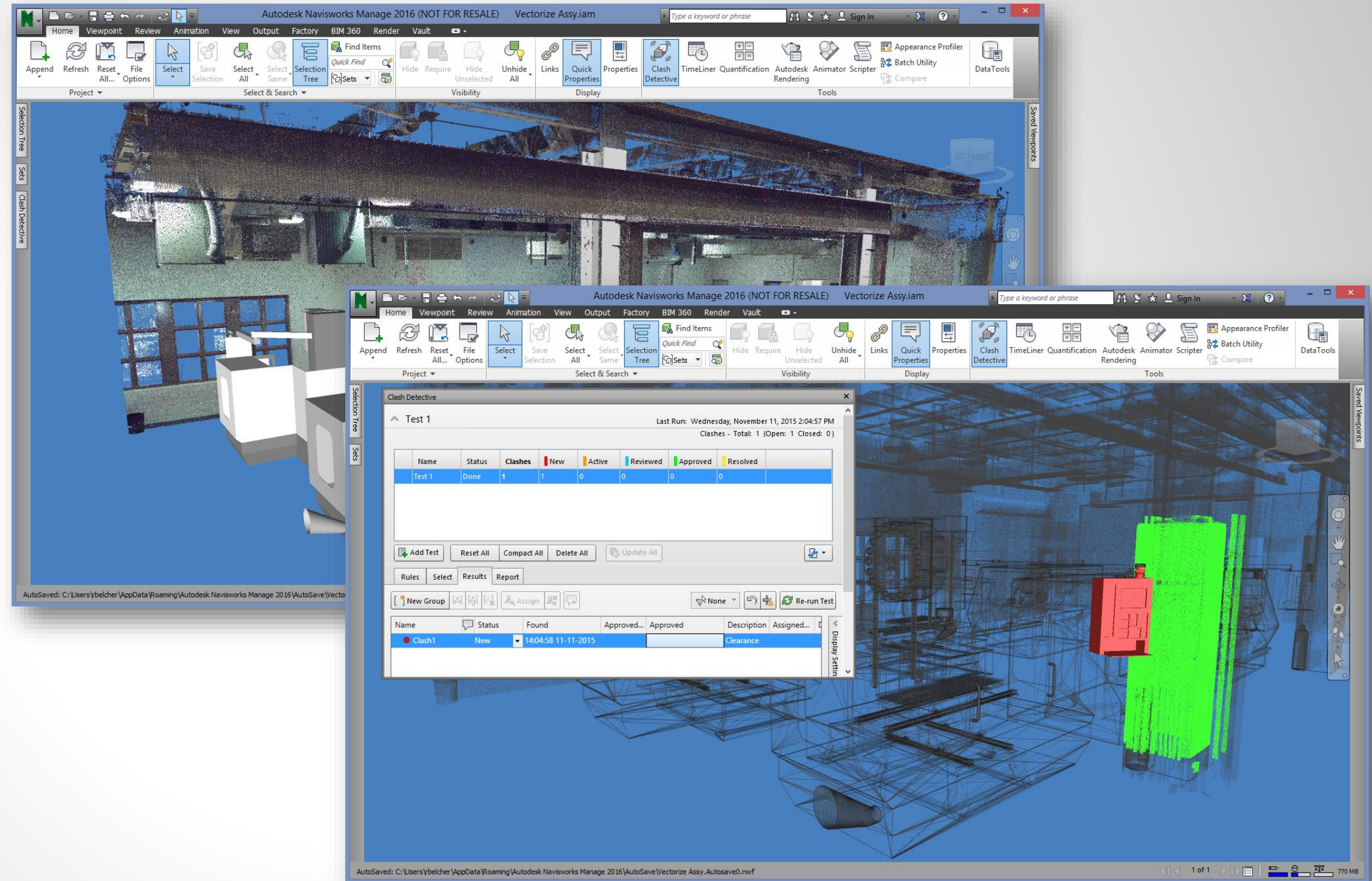
- 3D assets are placed in context of the cloud.
- Assets can be snapped to the DWG Overlay.
- The Cloud provides the Real World context for the asset location.
- Allows the Digital components to be visualized in context of reality.



The merging of digital design and reality.

Factory Layout in Navisworks

- Realistic Walks Through the Cloud.
- Clash Detection between Points and Digital Assets.
- Compare the Digital Design to the Reality Capture.



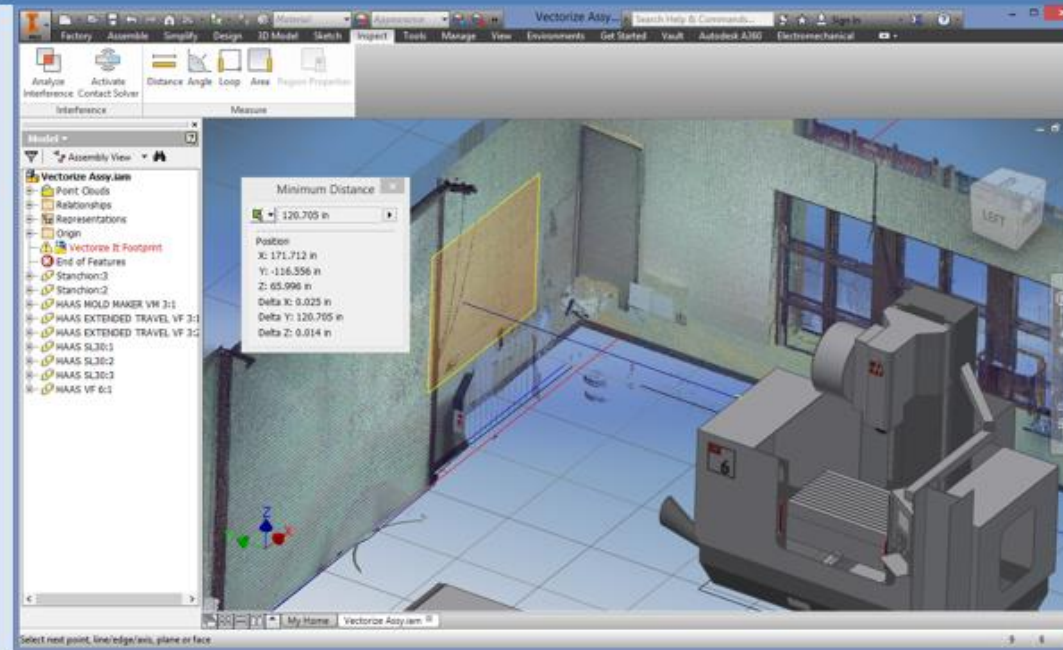
Analyze the digital assets in way of the Point Cloud – Clash Detection

Additional Point Cloud Tools Available in FDS

Point Cloud Analysis Tools in FDS

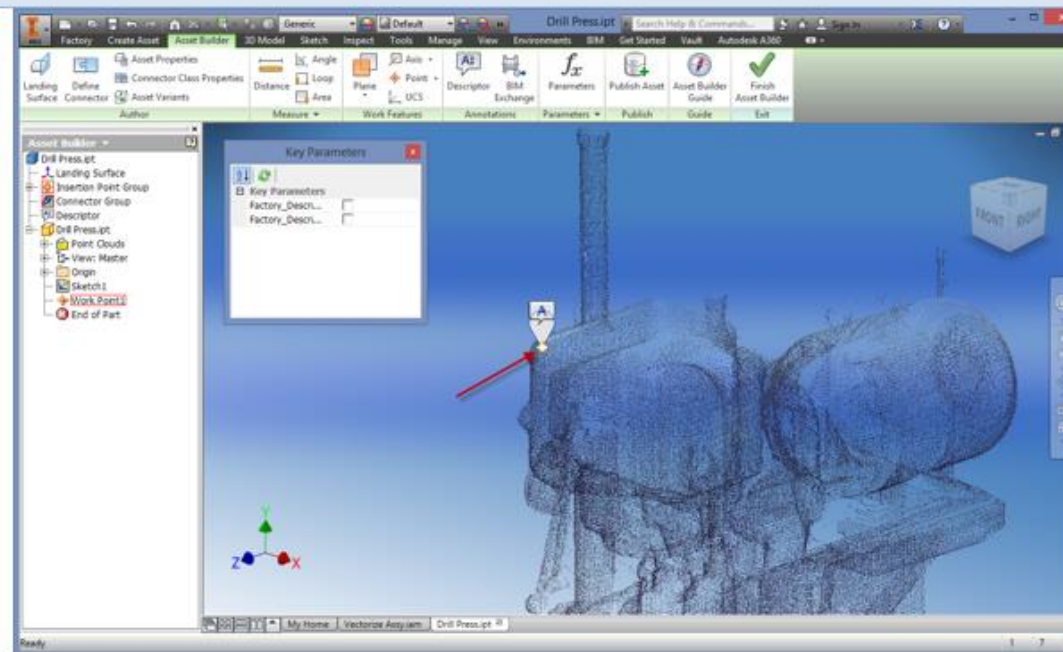
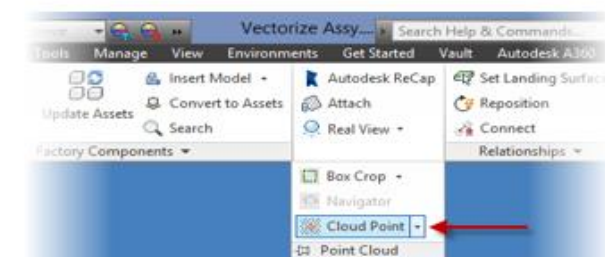
Inventor - Measuring a Distance to a Point Cloud Plane

A group of planer points can be selected as a plane via the Measure Distance Command in Inventor.



Inventor - Cloud Point

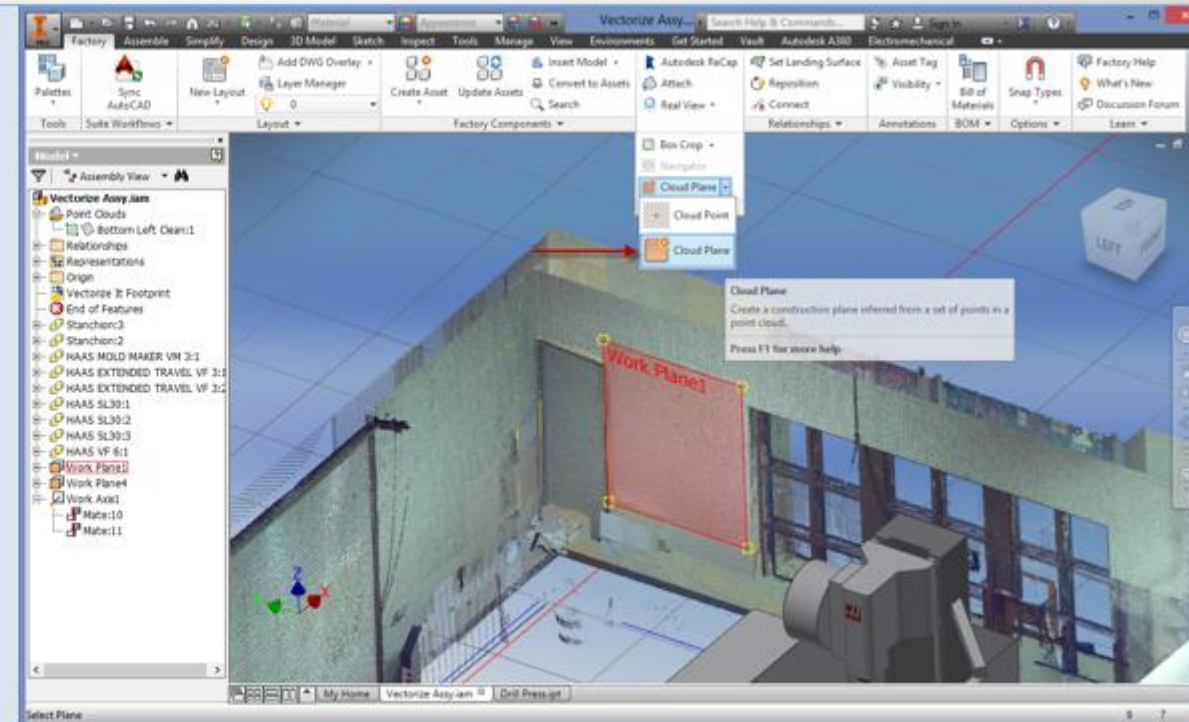
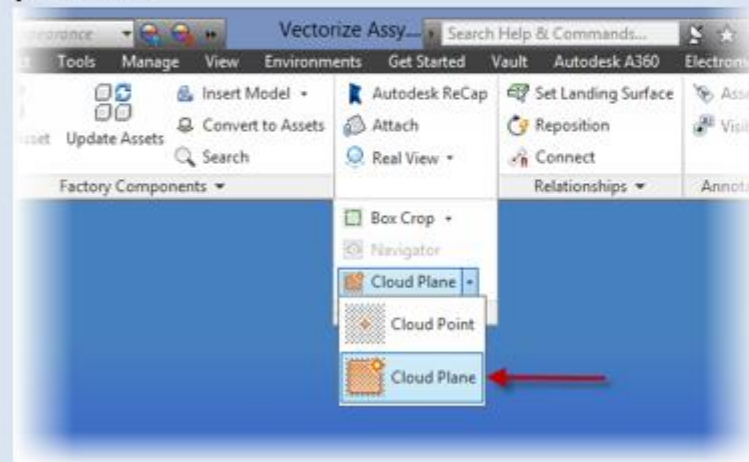
Places a work point on any single cloud point. The work point can be used to generate additional work features, or as a selectable location for asset insertions or descriptors.



Additional Point Cloud Tools Available in FDS

Inventor - Cloud Plane

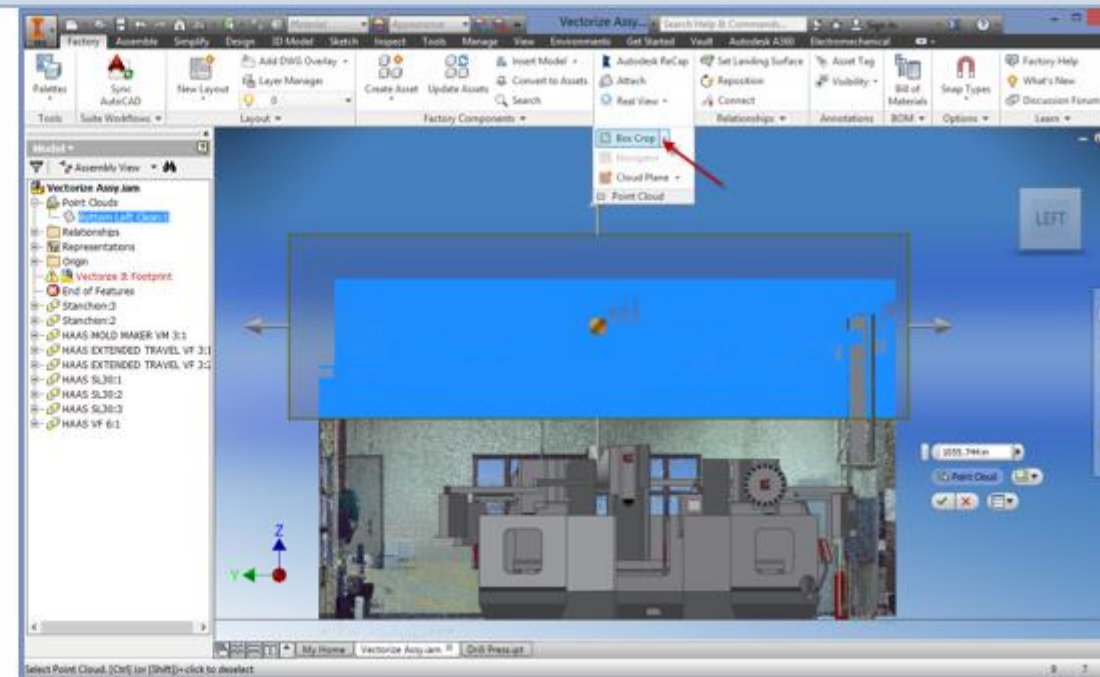
Places a workplane on a group of planer points.



Inventor - Box Crop

Allows users to hide a portion of the point cloud.

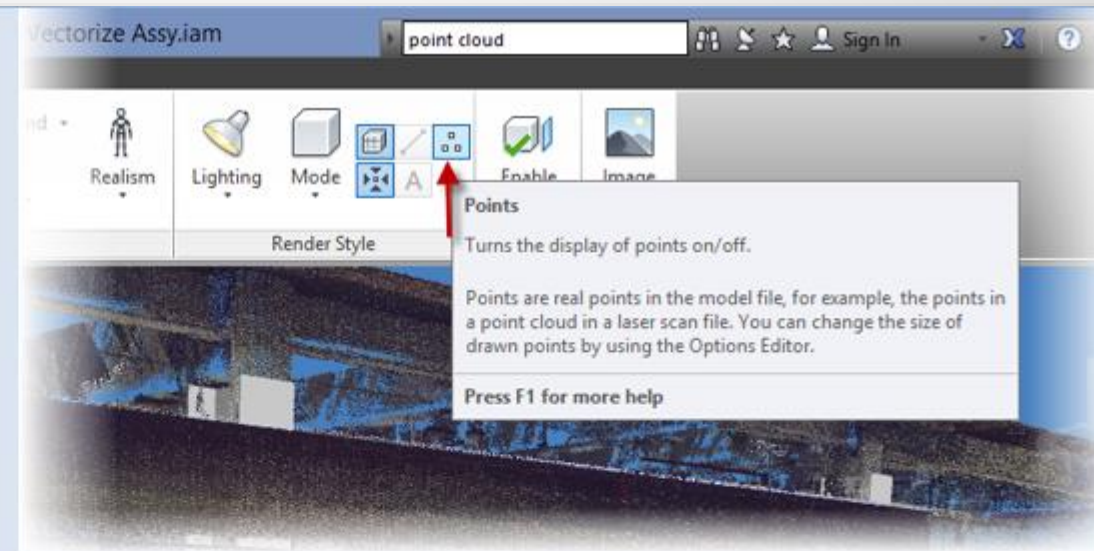
Note: You can hide the points inside or outside the box.



Additional Point Cloud Tools Available in FDS

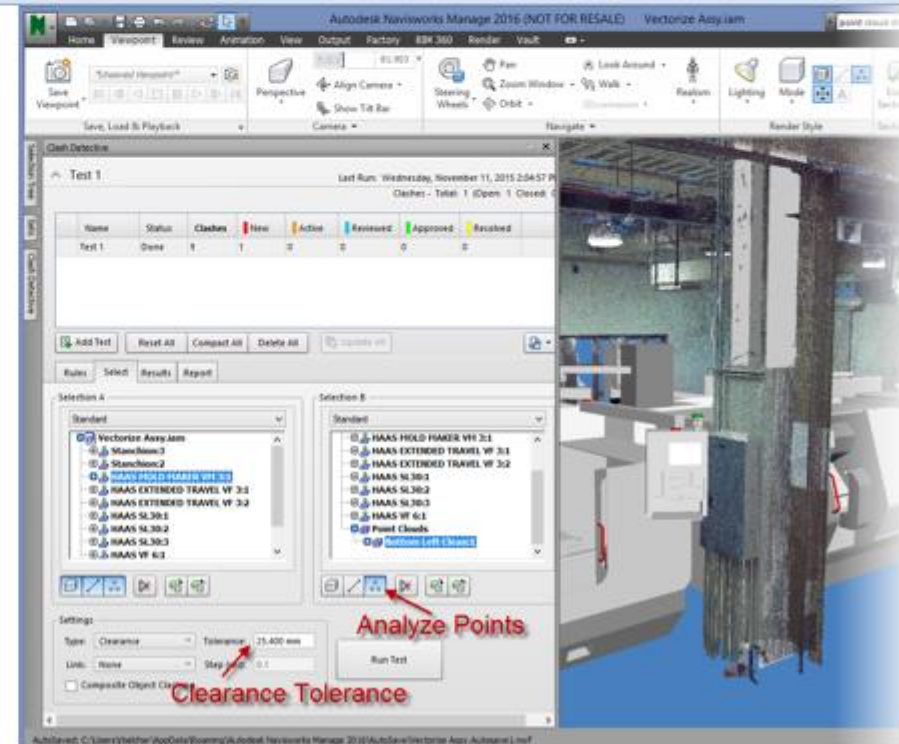
Navisworks – Point Display

Toggles the visibility of points in the scene.



Navisworks – Clash Detective – Clearance for Points

Performs a clearance analysis between solids and points.

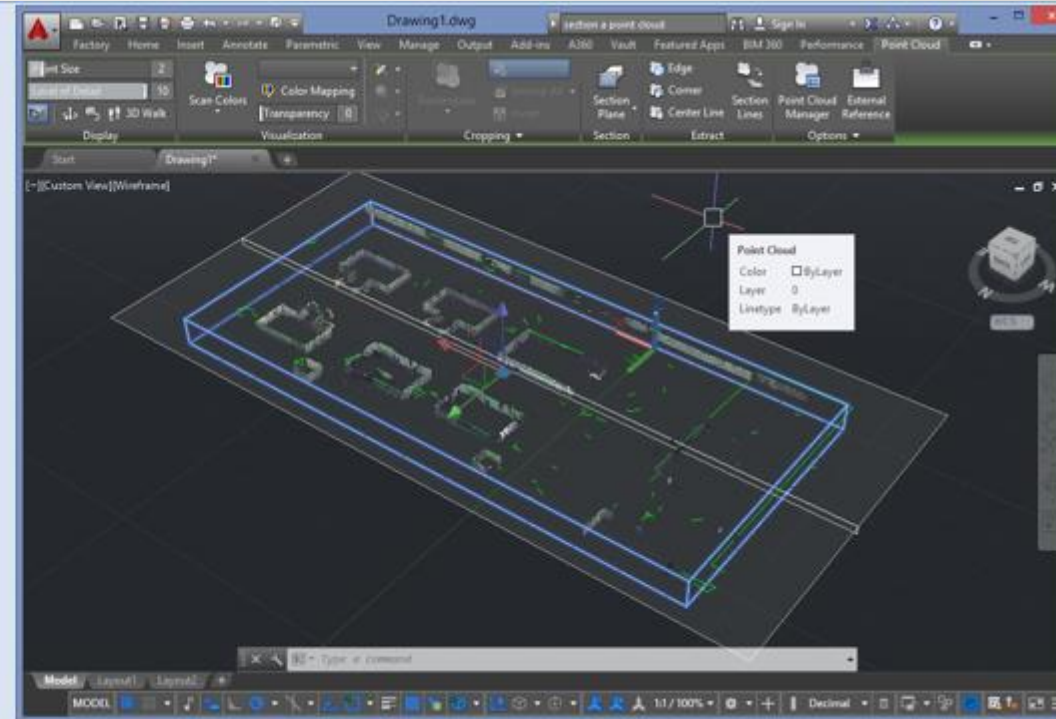


Additional Point Cloud Tools Available in FDS

AutoCAD – Point Cloud Tools

AutoCAD offers several point cloud analysis tools that allow users to extract geometric information from a scan.

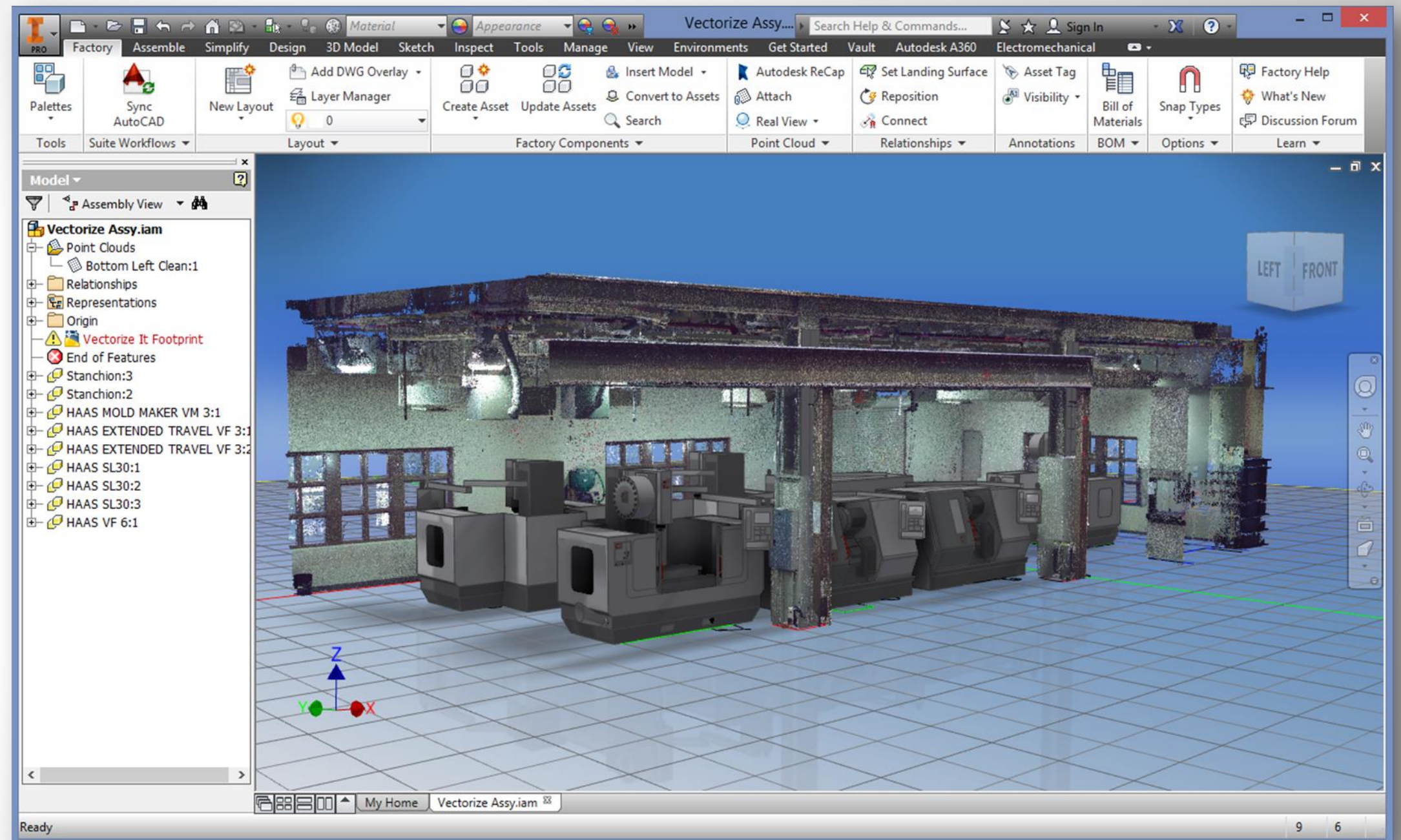
- Extract Section Lines
- Extract Edge
- Extract Corner
- Extract Centerline of Cylinder



Using a Point Cloud as a Factory Asset

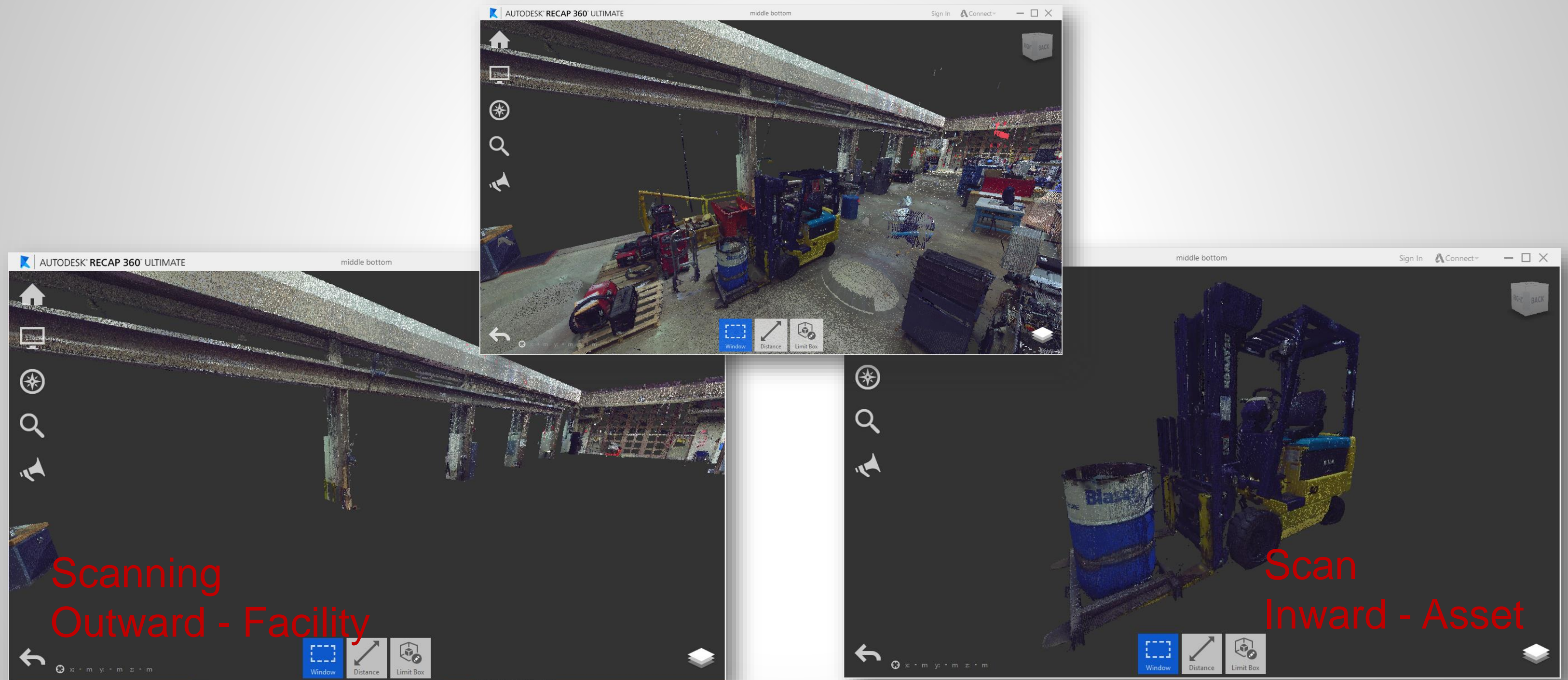
The Traditional Use of Point Clouds in FDS

- Walls
- Windows
- Doors
- Ceiling
- Architectural Components



Point Clouds are usually used to represent the Architectural Design in FDS

Point Clouds as a Factory Asset



Instead of Scanning Outward for the Facility, Scan Inward for the Asset.

Why use a Point Cloud instead of a Solid Model?

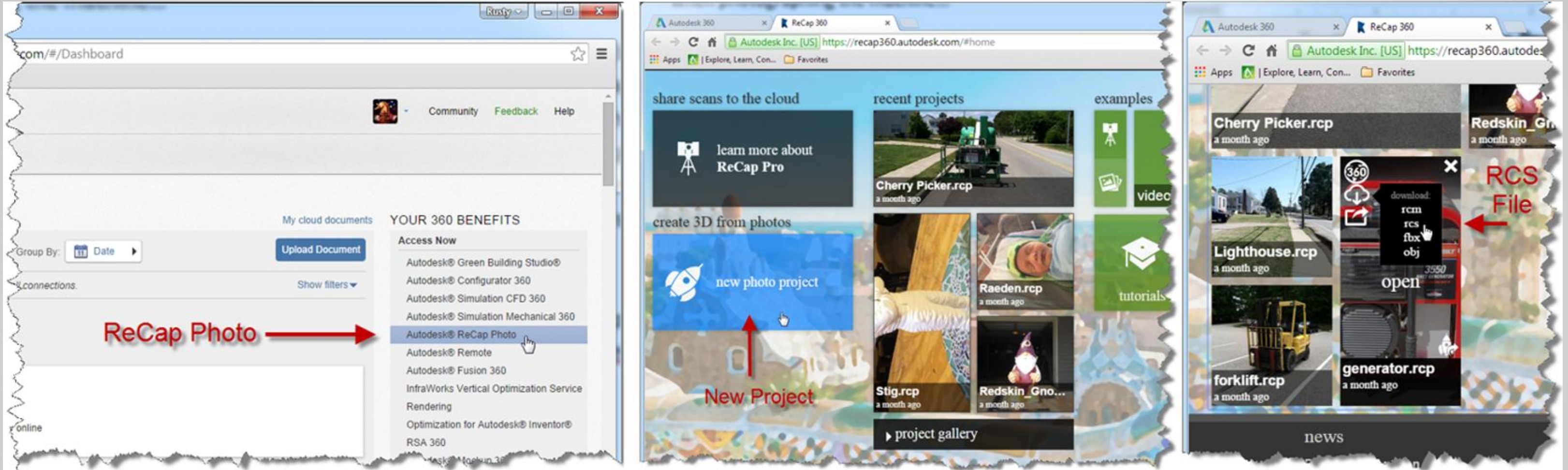
There are several reasons to consider using a Point Cloud as an Asset.

- Point Clouds can be generated from Scanners and Cameras in far less time than the creation of a Solid Model from many manual measurements.
- In many cases, the machine is actually sitting on the factory floor. In these cases, capturing the reality of the form is easier and more accurate with a point cloud.
- Point Clouds are generally easier to create. 3D models require experience and skill to produce.

Utilizing a Point Cloud as a Factory Asset offers several advantages.



ReCap Photo



In many cases, Point Clouds can be generated using ReCap Photo instead of a traditional expensive laser scanner.

The Pictures

Pictures for ReCap Photo

Include the entire machine in every picture.

Remember that the background helps to stitch the scan together.

Take pictures from High and Low angles.

Take pictures every 5 to 10 degrees as you circle the machine. Use a ladder to obtain images from higher positions as you circle the machine again.

In General it will require about 60 pictures per scan.

Avoid Reflection and Glare

Reflective surfaces are difficult to stitch together in the final scan. Do Not use a Flash.

Color Contrast - Background

The machine should contrast with the surrounding background.

Consistent Light Source

The machine should contrast with the surrounding background. (No Flash)

Textured Surfaces are Preferred

Textured Surfaces are easier to stitch in the final scan.

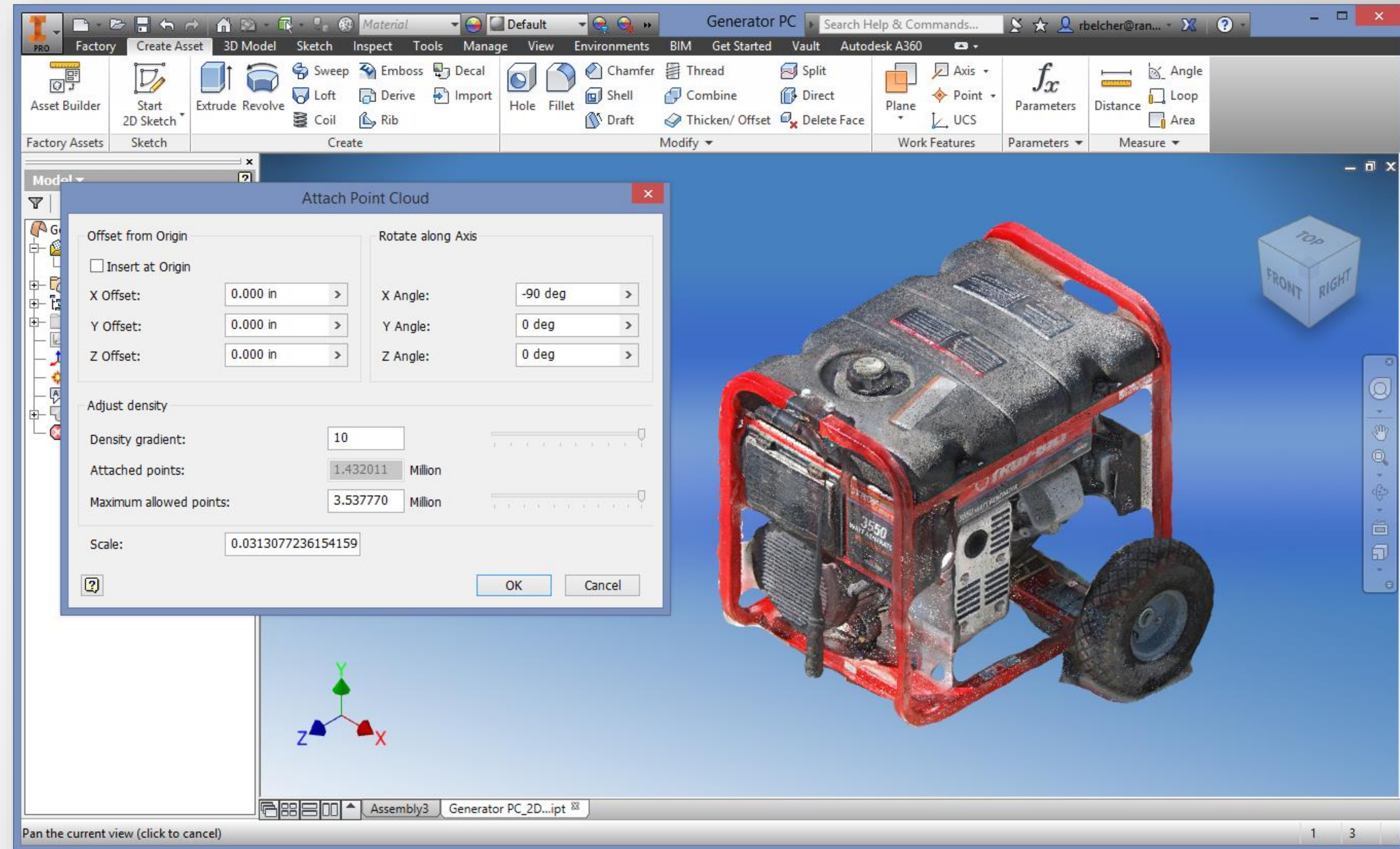


Autodesk ReCap



Use ReCap to orient the scan and remove any point that is not part of the asset.

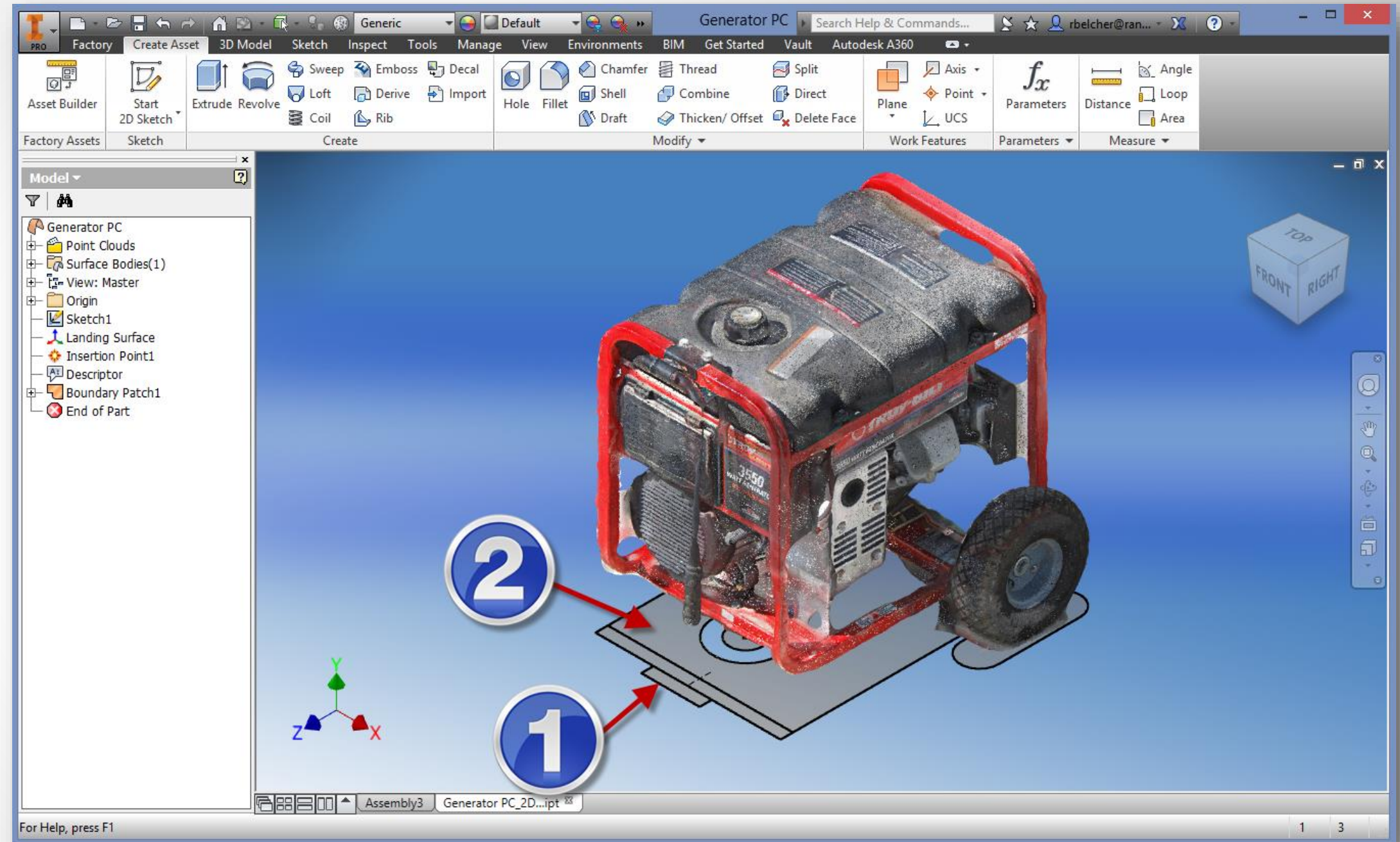
Bring the Scan into Inventor



The Orientation set in ReCap is honored when placing the scan into Inventor.

Preparing the Asset

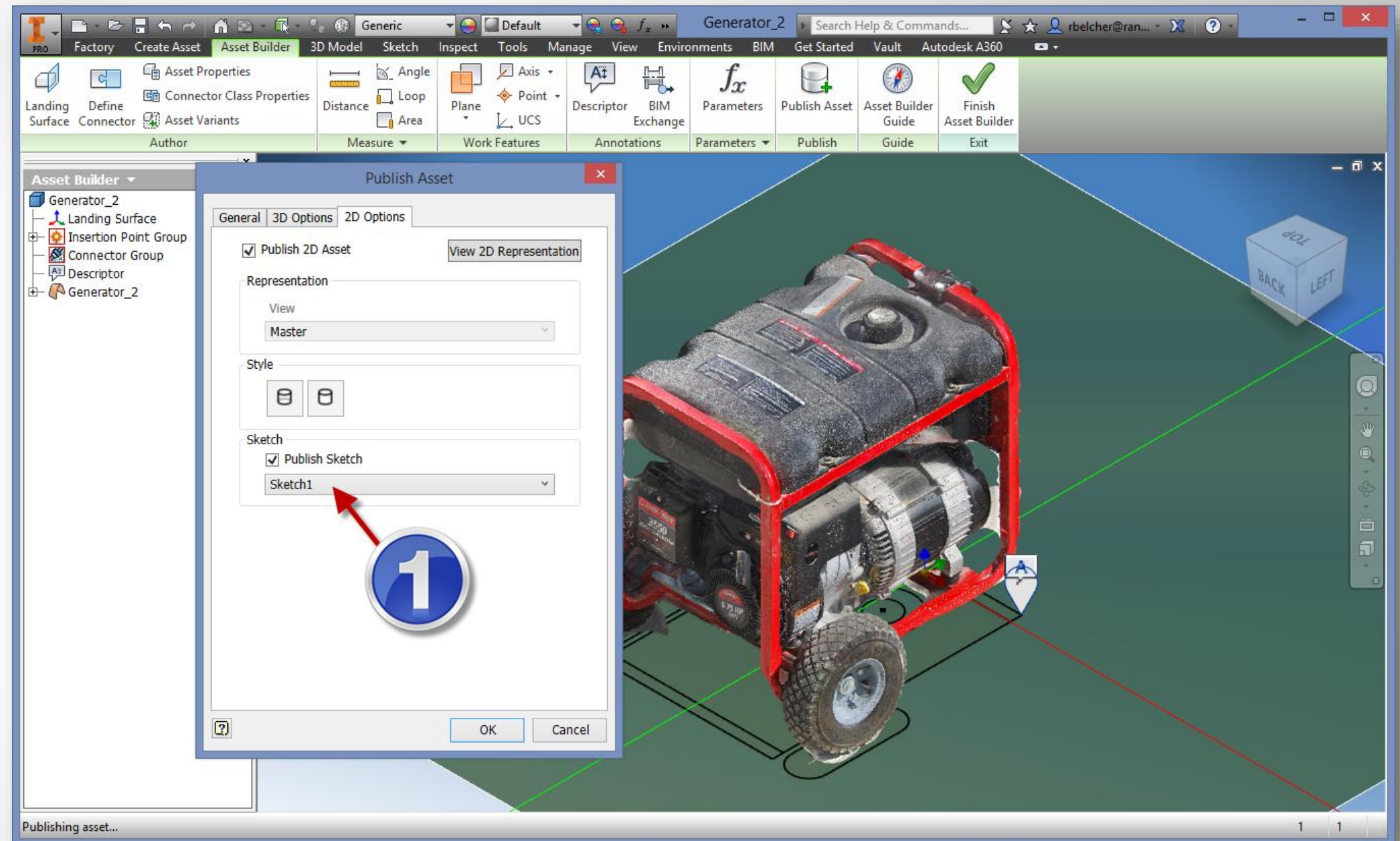
- (1) Add a simple sketch to the Ground Plane representing the top view of the asset.
- (2) Add a simple Surface Patch to the Ground Plane representing the outline of the top view of the asset.
- The Sketch and Outline Surface allows you to use the cloud as a functional asset.
- Point Clouds without the sketch are un-selectable.



Add additional sketches and surface patches so the asset functions correctly in Inventor, Navisworks, and AutoCAD.

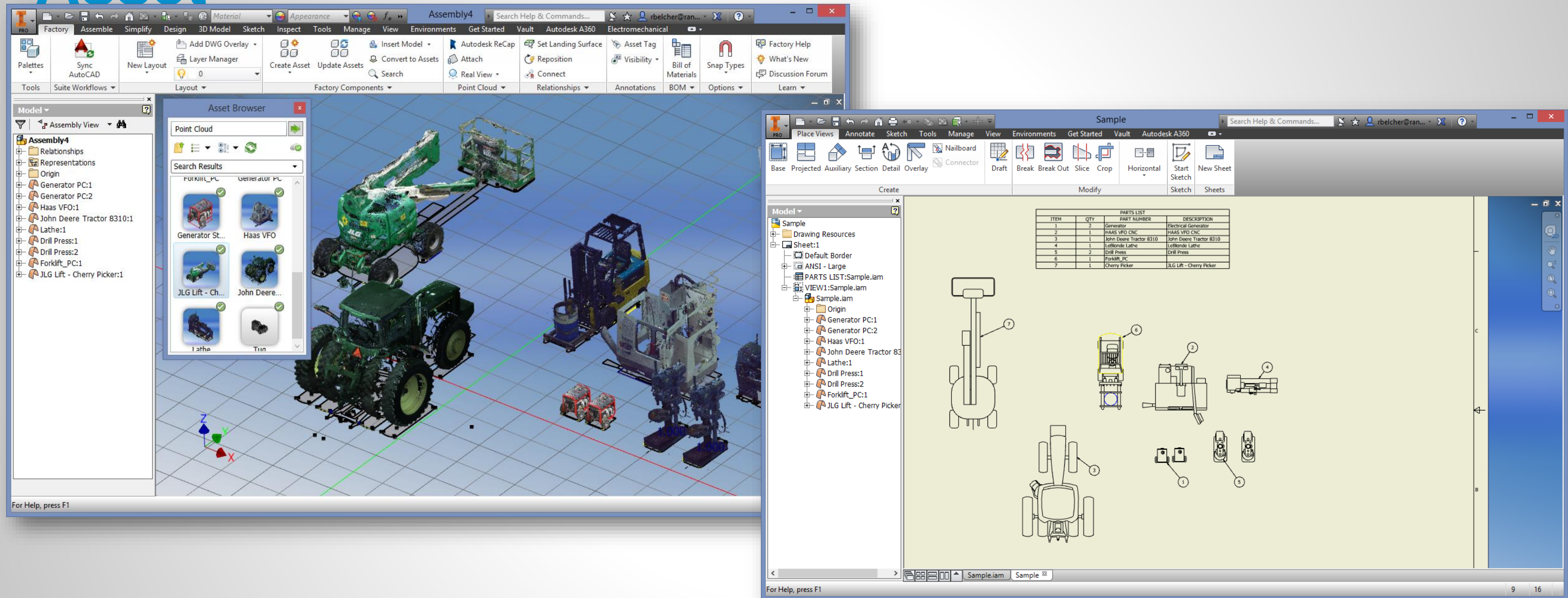
Publishing the Asset with Sketch

- Add the necessary iProperty information.
- Add a Descriptor (Optional)
- While Publishing, On the 2D Options tab, (1) select the sketch to represent the asset in 2D views.



When you publish the asset, make sure to select the sketch to represent the asset in a 2D view.

Any Type of Scan can be utilized as a Point Cloud Asset



Published correctly, the point cloud asset should act almost exactly like the 3D model counterpart.

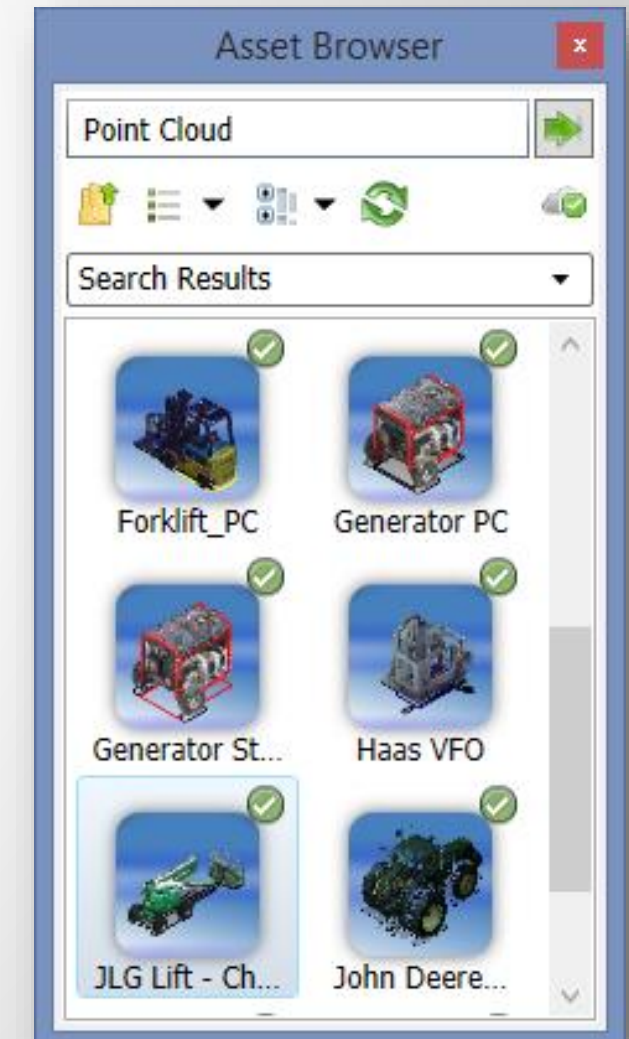
Pros and Cons of Point Cloud Assets

Pros and Cons of the Point Cloud Asset Workflow	
Pros	Cons
Why create a 3D solid model of a piece of equipment that actually exists on your shop floor?	3D modeling is the traditional method.
The creation of a point cloud can be faster than the 3D modeling process.	Point Clouds are not as accurate as Solid Models.
The creation of a point cloud can be easier than the 3D modeling process.	Point Clouds don't have mass, volume, or traditional surfaces usually required for downstream use.
Solid Models require many manual measurements.	Solid Models have a smaller digital footprint and do not require an external reference.
Designers must be experienced to create 3D models.	Scanning Technology must be acquired in order to generate Point Cloud scans.
Point Clouds automatically transfer from Inventor to Navisworks. (2016 Release)	

Recap and FDS a Great Combination - Conclusion

I hope this presentation has opened your eyes to the level of Point Cloud integration and support available in the Autodesk Factory Design Utilities. When it comes to designing a layout space in context of reality, Autodesk ReCap and the Autodesk Factory Design Utilities make a Great Combination.

Note: The assets highlighted in this demonstration are available in the Factory Design Suite Asset Warehouse. If you would like to download the assets and review their functionality, simply search the FDS Asset Library with the Key Words “Point Cloud”.



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