How Drone and Point Cloud Data Powers 3D Site Models

In this article, we're exploring the relationship between drone data, point clouds, and accurate georeferenced 3D models. And then, we'll explain how those three things synergize to make life easier on your worksite.

For a 3D model, value comes from its georeferenced data. Without it, there's no way to reference a particular point in your visualization against other information.

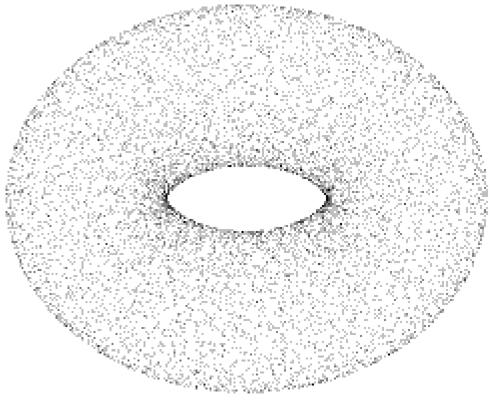
If your entire team references the same pool of georeferenced points, no one's making one-off, subjective measurements that are only relevant to their particular job.

It's location data that keeps you tethered to what's happening on a macro-level—you know, the big picture, and it's point clouds that make that georeferenced layer possible.

Here we'll discuss how drone data powers a point cloud, and how your point cloud serves as a georeferenced wireframe for building site models.

What's a point cloud? But first, a lesson in meteorology

Real clouds seem like they're solid when we look up at them. In reality, they're made up of many tiny condensed water droplets. As rising air cools, vapor molecules join together to form visible ice crystals. All together, they form a cloud.



Point clouds follow the same logic. If you take a thousand (or million) some geospatially-connected points, they form a three-dimensional virtual mass called a point cloud.

From a point cloud, you can make observations (and measurements) about an object's depth, elevation, geometry, and location in space. Since every point cloud is capturing unique physical attributes, all point clouds look different from one another and they come in all shapes and sizes.

Get as macro or micro with point clouds as you like—they range from capturing a single object to 500-acre worksites, conveying as-built or existing conditions.

Historically, GIS specialists, engineers, and surveyors have engineered point clouds using remote sensing laser scanners (lidar). The sensors measure a very large number of points along a surface to form a skeletal set of points.

Once a point cloud surface reconstruction caught the attention of a wider user base, collection mechanisms grew and the technology matured. Now, lidar and photogrammetry are the most common approaches to 3D point cloud generation.

If you're interested in the differences between lidar and photogrammetry, this article gets into the nitty gritty of it all.

The one thing equation to remember here? Higher density equals higher accuracy. Much like a cloud, the denser the points, the less fragmented it appears. Typically, with survey-grade point clouds, the distance between any two points is 2–3mm.

Recreating the physical world with point clouds is visually interesting and delivers a fresh perspective on designs or surfaces that you may be desensitized to otherwise. However, the benefits extend far beyond visual exploration.

For worksites, point clouds represent a raw, infrastructural source to drape aerial imagery over. With a set of data points in the coordinate reference system of your choosing, you can document site conditions at pivotal moments in the project timeline to track how far you've come and how much longer you have left till completion.

Point clouds are the raw output, while the final output—an interactive 3D model with real-world imagery—is a combination of an orthorectified mosaic image and a digital terrain model (DTM). Next, we'll dive into the relationship between drone surveys, point clouds, and (eventually) 3D models.

Drone Data + Point Cloud = Unstoppable Duo

From the images produced during a drone survey, distinct features are identified that can be seen in more than one image. Using the location of the camera sensor, the location of each distinct feature can be measured with triangulation.

In order to establish a coordinate for a distinct point from drone imagery, the point has to be captured in two images with known positions. The more features identified in the drone images, the denser the point cloud becomes.

Together, these points create a "cloud." If each known point describes a particular feature, the more points, the closer your point cloud will get to emulating your real-world topography.

Think about it this way: If photogrammetry (the science of measuring using images) is the equation for 3D models, point clouds are some of the dynamic values you plug into the equation, along with your raw imagery to get the final output. The final outputs are a 3D mesh and a digital elevation model (DEM) which is combined with the resulting mosaic orthoimage to visualize a 3D model of a site.

When your points are densely packed, the less your photogrammetry software has to interpolate what exists between them.

So, why should you care? It's simple: you can't build an accurate 3D model of your site without a point cloud. Out of the two methods for creating points clouds, lidar scanning and photogrammetry, photogrammetry is the most cost effective. Hardware and software come in at a considerably lower price than the lidar equivalent.

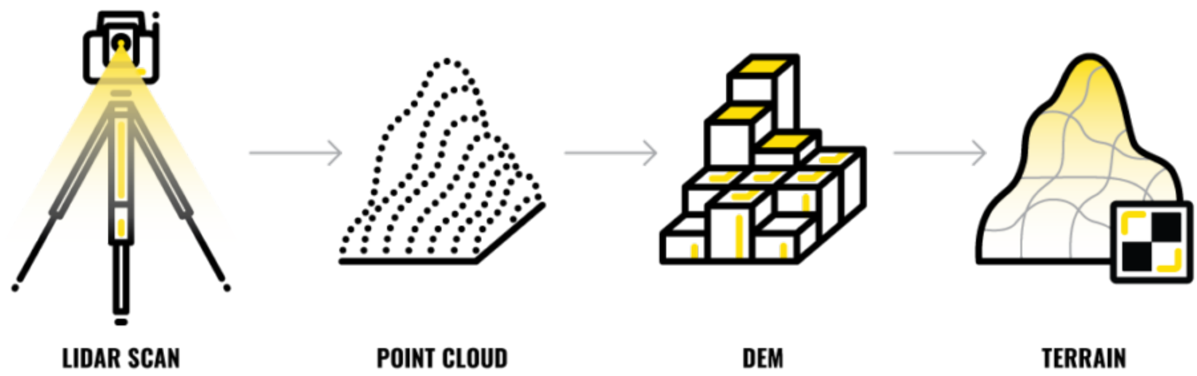
Also, photogrammetry creates a point cloud with enough accuracy for 99% of site work and mining applications, while requiring less than an hour of training to be proficient in drone collection.

The Simple 3D Model Recipe

Okay, so we've plowed through point cloud basics and talked about how drone data and point clouds work together. But, what's next? Obviously, the point cloud isn't our last stop.

The final (arguably the most important) ingredient in the 3D model recipe is a photogrammetry platform.

In theory, you could triangulate points manually, tagging X, Y, Z, but it would take an obscenely long time. The good news: this doesn't have to be your reality.



With the right photogrammetry platform, you upload all your raw data—your ground control points and drone data— toggle on your preferred coordinate reference system, and forget about it.

That's the difference between a mediocre platform and an intuitive one; one you find yourself worrying about, and one you trust to get the job done.

The photogrammetry platform stitches everything together in a neat, little 3D package and notifies you when everything's in order. The platform provides a place to not only store your surveys, but to visualize and measure your 3D models.

No stressing about computer crashes or getting caught up in the data processing, just fast, actionable results that keep you and your team connected to your project.

Worksites around the world are using 3D, geospatially accurate records as a single source of truth. You might be wondering what we mean by "a single source of truth."

We could say OSHA is the single source of truth for safety regulations in the US, or the EPA for environmental concerns. Let your up-to-date 3D model be the point of reference for your entire team, the source of truth for material movement, progress, and all things earthwork.

The next step? Watch a demo to see how 3D models create a single source of truth for worksites.

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