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Why excavator 3D machine control is right for you

3D machine control is not as expensive – or as complex – as you thought.

You've decided it's time to investigate putting a 3D machine control system on your excavator. As you begin to research, though, the prospect of winnowing through all the companies and products quickly becomes daunting.

As does the price.

So, it might be best to first take a step back and explore the reasons why you want to venture into 3D machine control.

You may be bidding a project where your 2D system has too many limitations. It could be that you've been impressed with what a friendly competitor has been able to do with his or her system. Or you've decided to make the leap from manual grade checking to 3D because a job requires it.

Everyone starts at a different place. But now that you're ready to take the next step we're here to help.

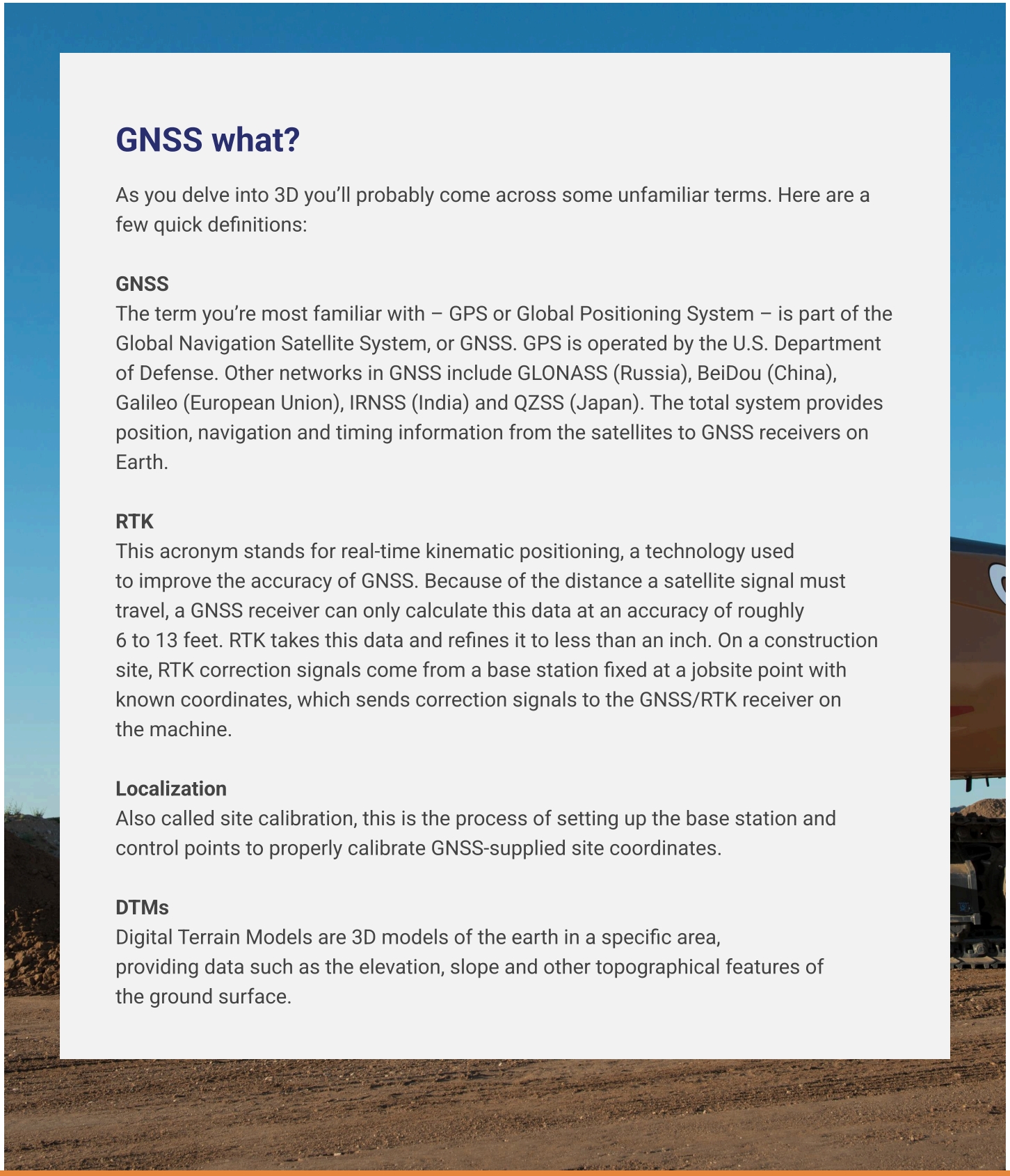
What 3D Offers

You may be familiar with how 2D operates, using a combination of sensors, laser receiver and laser to allow you to grade check from the cab. Great stuff.

3D technology elevates 2D capabilities to a new level. It provides constant, real-time positioning of your machine relative to the worksite, regardless of machine movement. Whether you've shifted 5 or 50 feet from your previous excavation point, a 3D system instantly recalibrates, offering precise guidance for your next cut. This continuous awareness of your machine's location enhances efficiency and accuracy throughout the job.

The secret sauce is the addition of a GNSS receiver and antennas on the machine. This system captures two crucial signals: direct GNSS signals (including GPS) from orbiting satellites, and RTK-corrected signals from an on-site base station. The machine's on-board receiver and sensors process this data, providing real time guidance. This ensures that your excavation precisely matches the design you either created using the tablet software in your cab or the digital terrain model uploaded to your machine.

All of this offers tremendous benefits. It has been said that 3D machine control is the biggest productivity boost to construction equipment since the advent of hydraulics. *That's a strong statement.*



GNSS what?

As you delve into 3D you'll probably come across some unfamiliar terms. Here are a few quick definitions:

GNSS
The term you're most familiar with – GPS or Global Positioning System – is part of the Global Navigation Satellite System, or GNSS. GPS is operated by the U.S. Department of Defense. Other networks in GNSS include GLONASS (Russia), BeiDou (China), Galileo (European Union), IRNSS (India) and QZSS (Japan). The total system provides position, navigation and timing information from the satellites to GNSS receivers on Earth.

RTK
This acronym stands for real-time kinematic positioning, a technology used to improve the accuracy of GNSS. Because of the distance a satellite signal must travel, a GNSS receiver can only calculate this data at an accuracy of roughly 6 to 13 feet. RTK takes this data and refines it to less than an inch. On a construction site, RTK correction signals come from a base station fixed at a jobsite point with known coordinates, which sends correction signals to the GNSS/RTK receiver on the machine.

Localization
Also called site calibration, this is the process of setting up the base station and control points to properly calibrate GNSS-supplied site coordinates.

DTMs
Digital Terrain Models are 3D models of the earth in a specific area, providing data such as the elevation, slope and other topographical features of the ground surface.

The Three Cs:
Cost, Complexity, and Compatibility

Cost

The first thing to realize is that there is a wide range of cost and features with 3D system vendors. Here's a key point: in some cases, the cost differential is so substantial you could outfit two machines for the price of one. That kind of savings can dramatically enhance your go-to-market capabilities!

But upfront costs are one thing. What you will save by not over- or under-cutting a job is another.

Consider this scenario: After excavating a 1,650-foot-long slope, you discover that you've overcut by 54 square feet along the entire slope. This error has led to an extra 25 hours of excavator operation. At an average rental rate of $125 per hour for a mid-size excavator, this error has set you back an extra $3,125. Ouch.

It gets worse. This figure doesn't include the extra fuel, wear and tear on the machine, per-hour labor cost of the operator, the truck that the machine is loading, nor the per-hour cost of the truck driver. Plus, it doesn't factor in the opportunity cost of the excavator being unavailable for other tasks. In the end, you've incurred a substantial, avoidable expense.

A 3D system helps you avoid this situation by giving you precise grade guidance as you work your way down the slope.

Complexity

3D systems come with a range of features that require knowledge to install, operate, and troubleshoot effectively. The presence of numerous cables, antennas, sensors, and a receiver can add complexity to the setup process.

Then there's the software component. How many file formats does the system support? Can it talk to all satellite networks? Can it work with all brands of equipment?

Finally, it's common for crews to feel apprehensive about learning 3D technology. This is where the training your vendor provides becomes critical. But based on our experience with hundreds of contractors, it should only take a few hours to move your crew from being rookies to competent users.

Compatibility

If you have existing legacy hardware, such as base stations, it's important to ask whether your new 3D system will be compatible with your current equipment.

Is the tide turning on machine control use?

For years, only a minority of contractors used machine control systems. A 2024 **Equipment World website poll** shows how much that may have changed.

Nearly half of poll respondents – 46% – said they were using machine control, with 16% using 2D and 30% using 3D. Top benefits cited included increased accuracy, efficiency and cost savings.

"It saves labor and time, as the equipment tells me if I'm at depth and I don't have to stop and wait for someone to tell me what I already know. By then, I'm two more feet down the trench at grade," said one respondent. "It makes your operating costs more competitive," added another.

Let's Talk About Transferability

There's no doubt: having to equip every machine in your fleet with a 3D system multiplies the cost beyond what many contractors can bear.

Some machine control systems use a control box, a GNSS receiver, two external antennas, multiple cables and a radio for RTK corrections. These systems require two antennas mounted on the machine, often by welding masts to the counterweight. This set up restricts the types of machines that can accommodate these systems.

Picture a scenario where one 3D system could be used across several pre-wired machines. Although this setup involves some initial investment, it's considerably more cost effective than installing a complete system on each machine.

What are the components of a 3D system?

First, let's look at what's needed outside a machine. This usually means a base station, which receives the satellite signals, corrects them with RTK technology, and sends them to the machine.

You might also use a DTM, or digital terrain model, of the job. This is created before work starts and uploaded to the machine's on-board computer. Another option is to use the 3D system software to create in-field designs of simple jobs such as pads, slopes and ramps.

Designed to calculate the exact position of the bucket cutting edge as you move through a jobsite, 3D hardware mounted on an excavator includes:

A46 GNSS Antenna

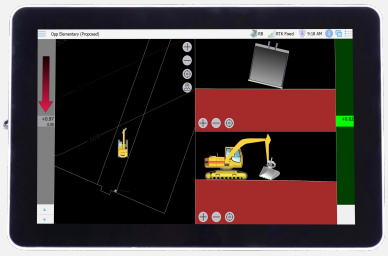
Antennas

Receives and amplifies the signals from GNSS satellites and converts them to an electronic signal for use by the GNSS receiver.

GradeMetrix VR1000

Receivers

Placed in a protected area in the interior of the machine, this unit receives GNSS and RTK signals from satellites and the base station and processes them into positioning data, which it then forwards to the in-cab tablet via a cable.



GradeMetrix IronTwo Tablet

In-cab Touchscreen Tablets

Connected to the receiver, the tablet allows operators to monitor and control the 3D system. Users can quickly toggle between features, including project set up, type of bucket used, etc...

GradeMetrix Sensor

Sensors

Sensors measure and report findings to the in-cab tablet. These include:

- Pitch and roll sensor placed in the upper body of the excavator.
- Boom sensor, which measures angle movement of the boom.
- Stick sensor, which measures angle movement of the stick.
- Bucket sensor, usually placed either on the excavator's dogbone, which measures the bucket's open/close movement.
- Optional tilt sensors measure the sideways tilt of a tilt bucket.

Machines

A 3D-equipped machine provides the essential third point in triangulating position.

Final thoughts

Quite simply, implementing a 3D machine control system elevates your operations. Equipping your operators with new capabilities will boost their confidence, enabling them to significantly enhance their precision and productivity.

Your team will achieve accurate cuts on the initial attempt, and you'll be able to precisely measure material quantities, minimize surveying expenses and improve overall safety. This technological upgrade empowers both you and your workforce to perform more efficiently and effectively.

2D versus 3D Machine Control explained

Still wondering how 2D and 3D machine control stack up against each other? Dive into this fun **video** from Bryan Furnace of Diesel and Iron. He breaks down the differences in a lively, easy-to-follow overview.

Want to know more?

We stand ready to help get you started on your 3D journey. Our experts will be there to answer your questions and match what you need with our great solutions. **The journey starts here**.

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