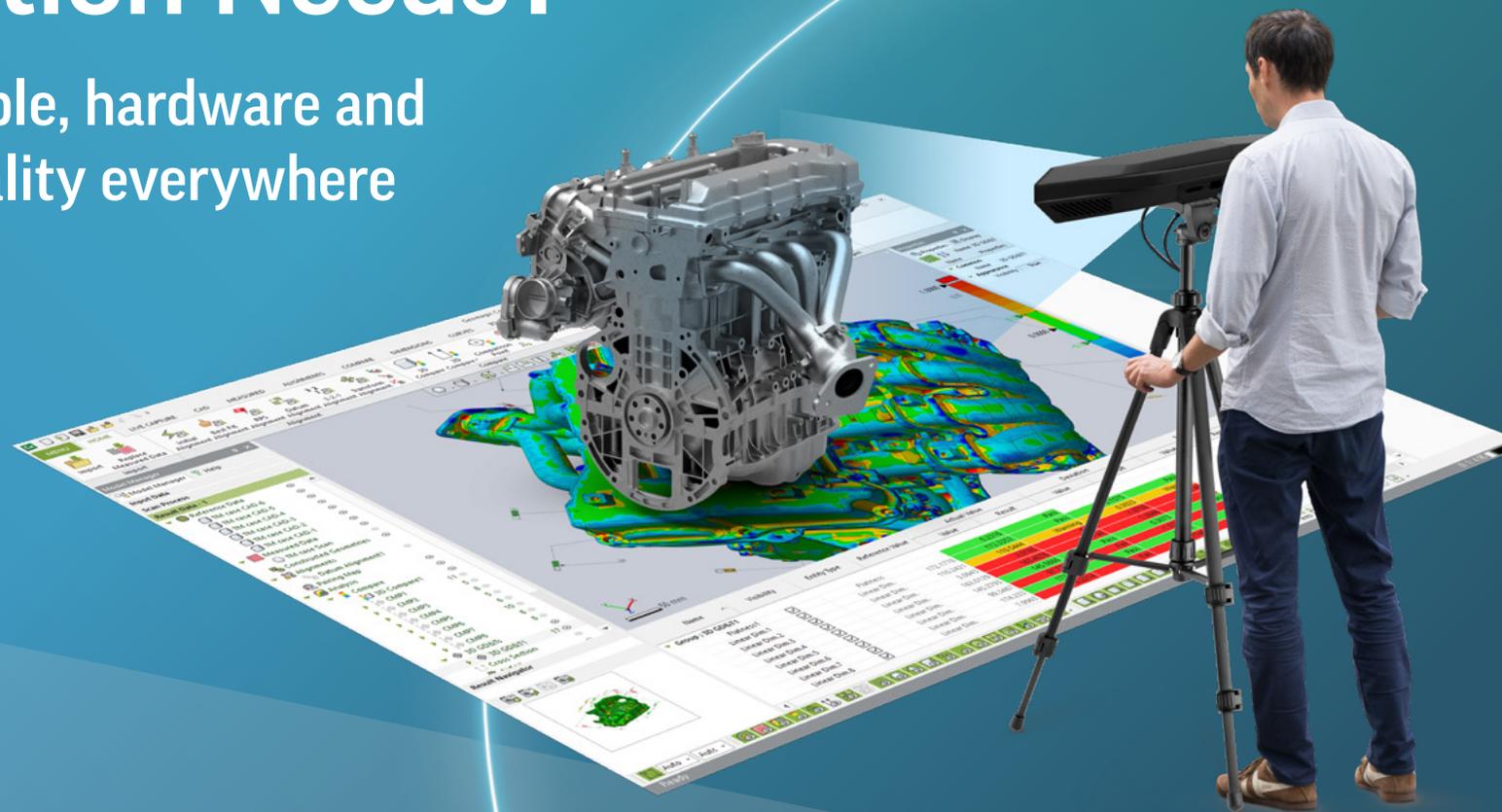


eBook

# Is 3D Scanning Right for Your Inspection Needs?

Combine the right people, hardware and software to ensure quality everywhere



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# Introduction

Combining the right people, hardware, and software to ensure quality everywhere

Quality and reliability matter more than ever. In today's hypercompetitive environment, companies can't afford to lag behind when it comes to the quality of their products. And management can't lag behind when it comes to adopting new tools and technologies to ensure quality everywhere.

Over the past two decades, 3D scanning has become a crucial tool in many manufacturers' measurement and inspection arsenals. It's an effective metrology technique that is trusted for its accuracy, reliability, speed, and ease of use. Its non-contact nature and exceptional flexibility make it ideal for measuring a wide range of parts in a wide range of places.

An effective approach to 3D scanning requires matching the right **people** with the right **hardware** and the right **software** to best meet your company's measurement needs.

**This eBook will help you determine if 3D scanning is right for your inspection needs, and if it is, how best to go about implementing the technology in your business.**



# Signs You Really Need 3D Scanning

3D scanning is becoming an essential component of many companies' quality control strategies. If you haven't started leveraging this rapid non-contact measurement technology yet, here are the key warning signs that indicate it's time to dive into the world of scanning.



## YOU NEED TO MEASURE COMPLEX PARTS

By measuring every surface at millions of points, 3D scanning makes it easy to measure even very complex shapes.



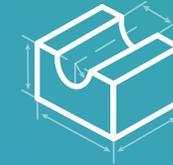
## YOU NEED TO MEASURE SOFT PARTS

Soft parts deflect or deform when touched. With a 3D scanner, the only things touching the part are photons.



## MEASURING PARTS TAKES TOO MUCH TIME

3D scanning is exponentially faster at collecting measurements than contact-based techniques.



## YOU NEED TO RE-MEASURE PARTS YOU DON'T HAVE

When you 3D scan something, you create a complete digital record that you can re-measure at any time.



## YOU'RE NOT SURE WHY SOME PARTS FAIL

Because 3D scanning measures the entire surface of a part, you're less likely to miss an unexpected deviation from nominal.



## YOU THINK YOU MIGHT BE SCRAPPING PERFECTLY GOOD PARTS

Do you ever wonder if you're unnecessarily scrapping parts? With a 3D scanner, you have a more complete view of your parts so you can make more informed decisions.



## YOU NEED TO MEASURE THINGS IN MORE PLACES

Sometimes it's more efficient to take the measurement tools to the part, rather than the other way around. Scanners and software are easy to use in the field.

# The 3D Scanner Landscape: High-level Overview

There are many 3D scanners to choose from, each with unique pros and cons. We've put together a general guide comparing each scanner type's strengths and weaknesses relative to the other types in this guide.

There are many nuances and differences among all the 3D scanners on the market so this is meant to be just a first step for you to consider what type of 3D scanner is right for you. The next step is to put together a short list of scanners to evaluate. We can help with that.



# Laser Triangulation Scanners

One of the most popular and versatile 3D scan technologies, laser triangulation scanners pass a laser line over the surface of a part, and using straightforward trigonometric concepts, calculate the distance from the sensor to the scanned object's surface.

COMMON LASER SCANNER TYPES	IDEAL SCAN OBJECT SIZE			ACCURACY	SPEED	PORTABILITY	UNATTENDED OPERATION	LOW COST
	SMALL longest dimension <25 cm/10 in	MEDIUM longest dimension <1 m/3 ft	LARGE longest dimension >1 m/3 ft					
STATIONARY AREA LASER SCANNERS	●●●●●	●●●●●	●●	●●●●	●●●	●●●	●●●●	●●●●●
PORTABLE CMM ARM LASER SCANNERS	●●●	●●●●●	●●●●	●●●	●●●●	●●●●	●	●●●●*
SELF-TRACKED LASER SCANNERS	●●	●●●●	●●●●	●●●	●●●●●	●●●●●	●	●●●●
LASER OR OPTICALLY TRACKED CMM LASER SCANNERS	●●	●●●●	●●●●●	●●●●	●●●●	●●●●	●	●●
STATIONARY CMM LASER SCANNERS	●●●●●	●●●	●	●●●●●	●●	●	●●●●●	●●●●*

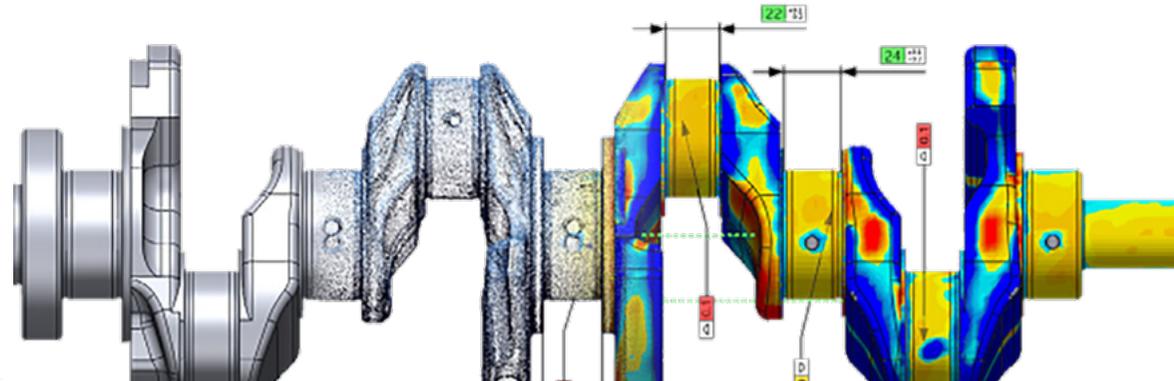
\* Not including the cost of the arm/CMM.

# Structured Light Scanners

Structured-light 3D scanners project a series of linear patterns onto an object and use sensors to recognize deformations in the patterns that indicate each pixel's distance from the sensor. These systems are often referred to by their light source, with white light or LED blue light being common approaches.

COMMON LASER SCANNER TYPES	IDEAL SCAN OBJECT SIZE			ACCURACY	SPEED	PORTABILITY	UNATTENDED OPERATION	LOW COST
	SMALL longest dimension <25 cm/10 in	MEDIUM longest dimension <1 m/3 ft	LARGE longest dimension >1 m/3 ft					
STATIONARY AREA STRUCTURED LIGHT SCANNERS	●●●●●	●●●●	●●	●●●●●	●●	●●●	●●●●	●●
ROBOT-MOUNTED AREA STRUCTURED LIGHT SCANNERS	●●	●●●●	●●●●●	●●●●	●●●●●	●	●●●●●	●●
SELF-TRACKED STRUCTURED LIGHT SCANNERS	●●	●●●●	●●●●	●●●	●●●●●	●●●●●	●	●●●●*

\* Not including the cost of the robot.



# Medium- and Long-range Scanners

For scanning larger objects such as heavy equipment, aircraft, ships, buildings, or factory floors, there are two primary technologies available: Phase-shift and time-of-flight laser scanners.

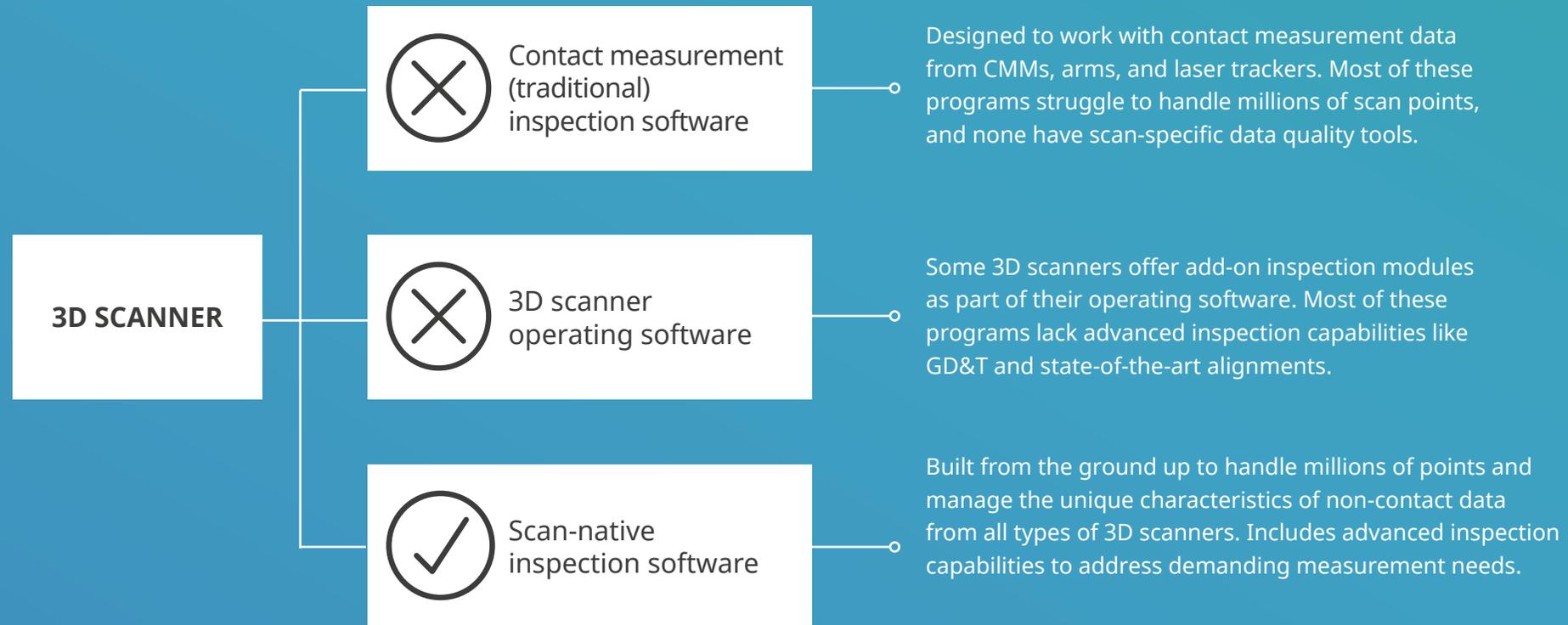
COMMON LASER SCANNER TYPES	IDEAL SCAN OBJECT SIZE		ACCURACY	SPEED	PORTABILITY	UNATTENDED OPERATION	LOW COST
	VERY LARGE longest dimension >1 m/3 ft and <30 m/100 ft	HUGE longest dimension >30 m/100 ft					
TIME-OF-FLIGHT LASER SCANNERS	●●●●●	●●	●●●●**	●●●●	●●●●●	●●	●●●●
PHASE-SHIFT LASER SCANNERS	●●	●●●●●	●●●●**	●●●	●●●●●	●●	●●●

\*\* These accuracy values are relative only to the other medium- and long-range scanner types. Accuracies of these scanners are generally >1mm, whereas all other scanner types in this guide achieve well under 1mm.



# Scanning is Only Half of the Equation

It takes more than a good 3D scanner to get reliable measurements. You need the right software too. Selecting a 3D scanner is important, but it's useless without software that can effectively work with point cloud data and let you get the information you need. There are three categories of software that are marketed to users of 3D scanners:



**Read on to understand why scan-native inspection software is the best choice for most serious users of 3D scanning.**

# Why You Need 3D Scan-native Inspection Software

## 1 USE YOUR 3D SCANNER TO THE BEST OF ITS ABILITY

Collecting copious amounts of measurement data is getting easier and easier. Modern 3D scanners collect 500,000 or even 1 million points per second, so you can measure the geometry of your parts with exceptional resolution and fidelity. Reliably taking advantage of all that information requires the right scan-native software.

Most 3D measurement software was not built to handle 3D scan data. Software built to use data from stationary or portable CMMs or laser trackers is optimized to work with a small number of discrete measurements that are known to be individually accurate. Working with 3D scan data is very different for a number of reasons. The companies that make these non-scan-native software have done their best to make their unoptimized software architectures work with scan data, but the reality is none of them do it particularly well. To fully exploit the potential that 3D scanning offers, make sure you select 3D scan-native inspection software to ensure everyone who uses it measures confidently and reliably.

## 2 INCREASE MEASUREMENT PRECISION

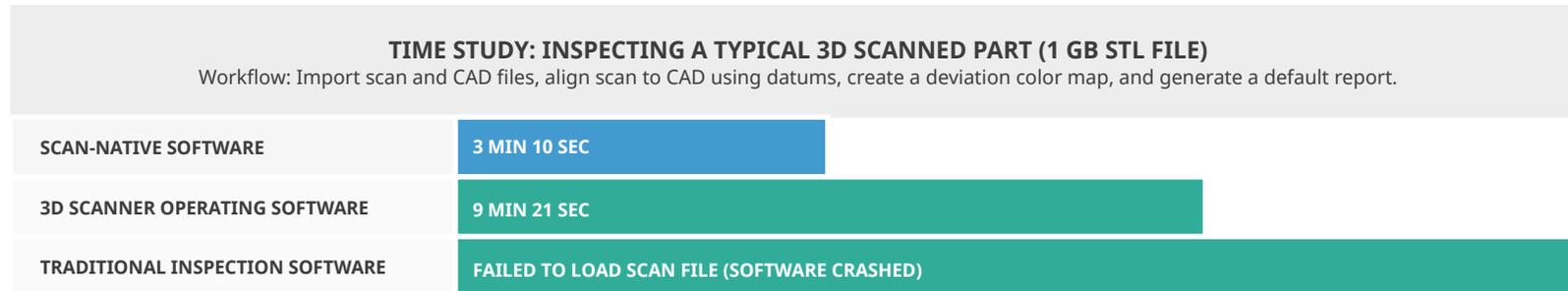
One of the misconceptions about 3D scanning is that it's inherently less accurate than contact measurement. All other things being equal, an individual contact measurement will likely exhibit less random error and therefore be more accurate than a single non-contact measurement. But with the right noise filtering, outlier removal, and geometry fitting algorithms, copious amounts of non-contact measurements can yield equally or more precise measurements of the position, shape, and size of features on a part. Look for 3D scanning software that has these scan-specific algorithms – not just standard CMM measurement and fitting algorithms scaled up to work with lots of data, which don't interpret scan data properly. Additionally, look for software that automatically determines the optimal settings for every scan and doesn't require users to become experts to attain reliable results.

# Why You Need 3D Scan-native Inspection Software

## 3 OPEN AND WORK WITH LARGE DATA SETS EASILY

When a typical 3D scan contains tens of millions of points, a software's ability to open and operate on such large data sets becomes a challenge. Using scan-native software can mean spending 3 minutes to complete an inspection on a scanned part, spending 10 minutes, or being unable to handle even moderately large scan files. That's the difference between

inspecting 18 parts per hour, 6 parts per hour, or being restricted to heavily sampled scan data. When you're counting on 3D scanning to help drive your business, these aren't just minor inconveniences – they add up to serious productivity losses when you don't have the right software.



Real world benchmark performed by 3rd party in July 2018. Shows total time required to perform a typical inspection workflow on the same scan and CAD files using each software on the same PC.

# Why You Need 3D Scan-native Inspection Software

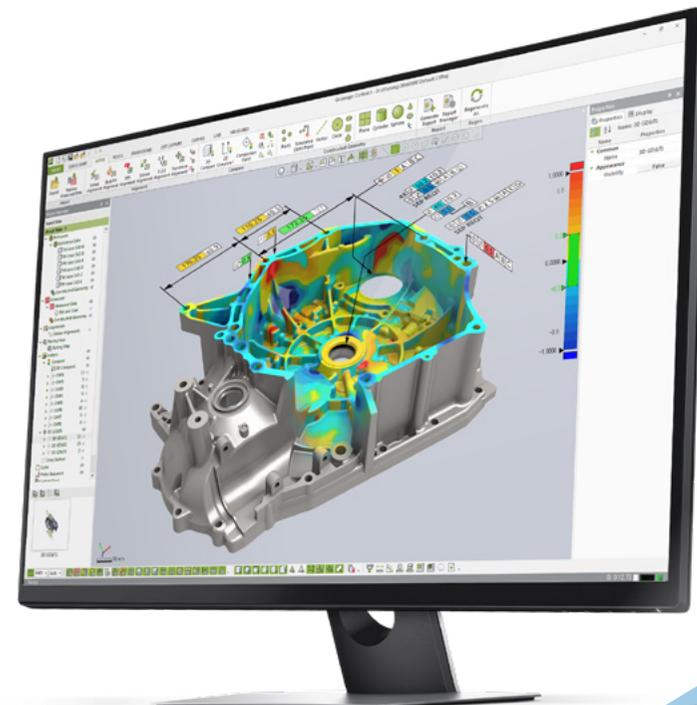
## 4 DISPLAY DEVIATION COLOR MAPS ON 3D CAD MODELS

Imagine looking for your keys in a pitch-black room. Would you rather use a flashlight that can only illuminate a small area of the room at one time, or flip the light switch and see the entire room at once? That's the difference between measuring a few dimensions on your part, versus seeing a full deviation color map that compares your scanned part with a nominal 3D model.

It's extremely helpful to have a color map on top of the measurements called out on a given part. It answers the questions those dimensions bring up. Many 3D measurement software will display a basic color map on top of an imported CAD model. But that's barely scratching the surface of the analysis you can do using 3D scan data. Look for software that can do more advanced deviation analysis, such as 3D, 2D cross-section, boundary, along curve, silhouette, and virtual edge comparisons.

## 5 USE GOLDEN PARTS FOR COMPARISON AND ANALYSIS

Don't have 3D CAD models to compare your scanned parts to? No problem. High-quality 3D scan-native software will also allow you to create clean nominal reference models from 3D scans of "golden parts" – parts that are perfect or nearly perfect – that you can then compare every other part to. The most advanced software will automatically define features on your scanned nominal so it will behave just like a full CAD model.

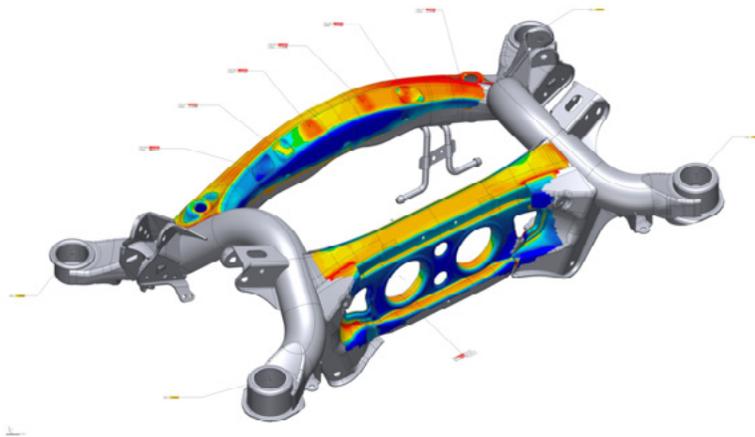


# Why You Need 3D Scan-native Inspection Software

## 6 MEASURE FEATURES WITH GD&T

Many people assume that it's better to measure basic geometric features using a contact measurement system like a CMM. When you have a limited number of features to measure, that may be true. For more complex parts with dozens or hundreds of individual features, it will almost always be faster to scan and then use software to identify and measure those features.

Look for software that can automatically identify features in a 3D scan, filter the data intelligently to remove noise and take reliable, accurate measurements. You'll speed up your inspections and be able to measure GD&T (Geometric Dimensioning & Tolerancing) on your scanned parts as well.



## 7 CREATE DIGITAL ARCHIVES FOR FUTURE USE

Every part that you 3D scan becomes a digital record that you can keep well into the future. The best 3D scan-native software will save the scan data, nominal model, alignments, and every measurement you've taken on that part in one efficient file that won't eat up unnecessary storage space. This makes it easy to go back to any part you've ever scanned to see exactly how the data was manipulated, what measurements were already taken, and take additional measurements whenever you need. Gone are the days of regretting not measuring more of your parts when you had them easily accessible.

In addition, the most advanced inspection software will learn your inspection routines and let you inspect every subsequently scanned part completely automatically.

# The Hybridization of Inspection and Reverse Engineering

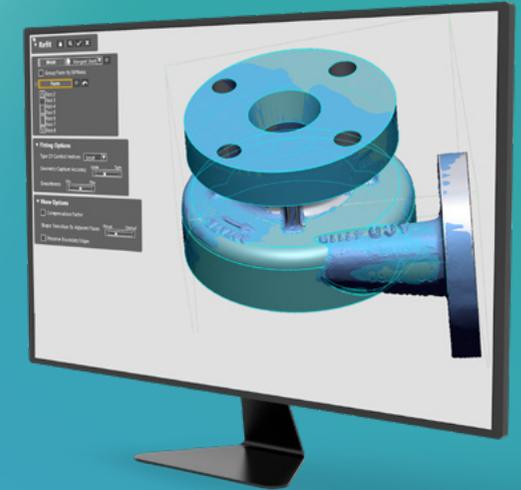
## UPDATE CAD MODELS TO REFLECT REALITY

There are a number of reasons you might want to update a CAD model to ensure it reflects the “as-built” condition of a part. For example, parts that have been cast or rough machined will always deviate from the intended shape due to heat and other stresses on the material. For more efficient fine machining or other finishing operations, it’s far better to work off of an accurate model that reflects the real part rather than an unmodified initial CAD model.

## CHANGE CAD MODELS TO COMPENSATE FOR PROCESS-INDUCED ERRORS

You can even go a step further than just updating CAD models to reflect reality. You can actually correct for part deformation caused by, for example, the injection molding process or metal stamping spring back. Almost any type of shape-related deformation can be compensated for after you’ve 3D scanned a part. You effectively “overcompensate” and modify the CAD model so that when the deformation occurs, you end up with a part that has the desired geometry.

3D scanning brings the power of reverse engineering to bear on these types of problems. When you invest in a 3D scanner, you gain the ability not only to measure your parts but also to update or recreate CAD models easily. Look for scan-native software options that combine inspection with reverse engineering & design capabilities to take advantage of this innovative approach to solving problems.



## DON'T JUST FIND THE PROBLEM, FIX THE PROBLEM.

Design, engineering and quality used to be in siloed departments that barely worked together. That era is (thankfully) gone now. Quality is everyone’s responsibility, and when an issue is found with a manufactured part, it’s important that the feedback loop goes all the way back to the design of the part. Today, that means making sure the 3D CAD model of that part is updated to either match the reality of the part as-manufactured (if the part performs within spec) or updated to compensate for process-induced manufacturing errors.

# Maximizing Your ROI

Ensuring you get the most out of your investment in 3D scanning is crucial. We've assembled a short list of the DO's and DON'Ts to help you maximize your return on investment.

## The DO list

### THINK DIFFERENT

We've seen a lot of companies just try to replicate their current measurement processes when they get a 3D scanner. But that's not the point of adding 3D scanning to your measurement arsenal. 3D scanning is unlike any other measurement technology. Get creative and solve more problems with it. Take advantage of the technology's strengths and avoid relying on its weaknesses.

### EMPOWER MORE PEOPLE TO MEASURE MORE THINGS IN MORE PLACES

One of the best things about 3D scanning is that the hardware and software are generally easy to use and portable. The most successful companies take their scanners to the parts they need to measure, and they open up the scanning and software usage to more people in design, engineering, manufacturing, and other parts of the business. With such flexibility and broad problem-solving potential, 3D scanning can drive value throughout your business.

### EVALUATE HARDWARE AND SOFTWARE INDEPENDENTLY. PICK BEST-OF-BREED.

You have a lot of great options when it comes to 3D scanning technology. Many of the vendors you'll talk to will recommend a bundled package of hardware and software. This is convenient, but make sure to research and evaluate both sides of the hardware/software equation with equal fervor. You'll end up with the best system for your specific needs when you insist on selecting the best scanner and separately selecting the best software for your needs. An excellent 3D scanner can be held back by mediocre bundled software, and vice-versa.

# Maximizing Your ROI

## The DON'T list

### VIEW THE SCANNER AS A PANACEA

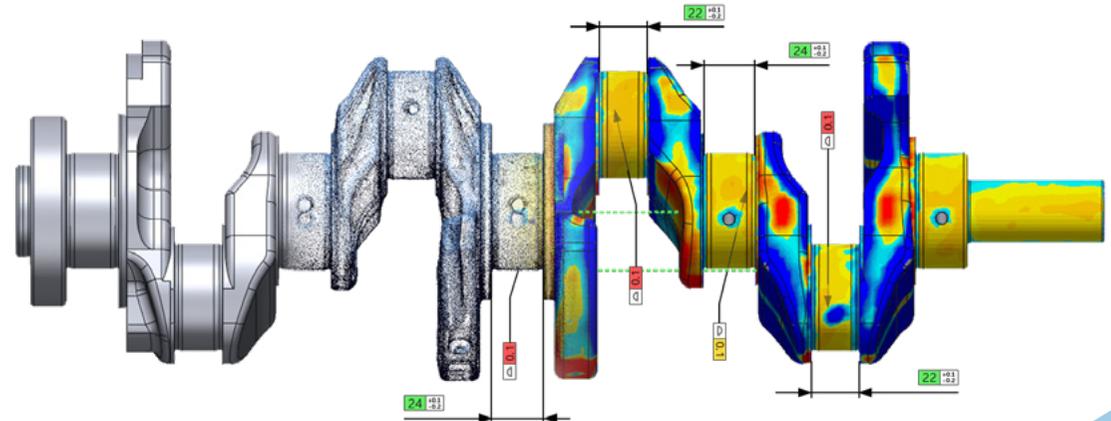
3D scanning is awesome technology that does a lot of things really well. But it's not a replacement for most of your existing measurement equipment. If you expect a 3D scanner to work well for all your needs across all your parts, you're likely to be disappointed. As noted above, think differently about measuring with 3D scanners. Leverage the technology for its speed, portability, comprehensiveness, and ease of use.

### ASSUME YOUR EXISTING METROLOGY SOFTWARE WILL WORK WITH YOUR SCANNER

You may already have 3D measurement software that you use with a CMM or other tools. Don't assume that because the software has a checkbox on its feature list that says "supports 3D scanners" that it will let you actually use your 3D scanner the way you intend. We've seen many companies struggle to get the value out of their 3D scanners because they're using software that wasn't designed to work with scan data from the ground up.

### TREAT SOFTWARE AS AN AFTERTHOUGHT

When most people begin their search for a 3D scanning system, they focus almost exclusively on the hardware. And while the scanner is important, getting the right software is equally important, if not more so. As discussed above, collecting huge amounts of scan data has gotten easier and easier. Figuring out how to best use that data can be a challenge unless you get educated on your software options and choose what's best for you.



# Why 3D Systems Geomagic

For over 30 years 3D Systems has bridged the gap between inspiration and innovation by connecting our customers with the expertise and digital manufacturing workflow required to solve their business, design or engineering problems. More than 2,500 3D Systems teammates, as well as thousands more people at our partners, are dedicated to helping you transform your business through manufacturing innovation.

## THE WORLD'S NUMBER ONE 3D SCANNING SOFTWARE PLATFORM

3D Systems' Geomagic software unlocks the potential of 3D scanning with advanced technology built to work with the massive data sets produced by today's high-end non-contact scanners. From scan-based design and reverse engineering to quality control, Geomagic software is an essential component of every 3D scanning system.

## ENSURE QUALITY EVERYWHERE WITH GEOMAGIC CONTROL X

Geomagic Control X is modern 3D scan-native inspection software that builds on more than 20 years of innovation in making the most out of 3D scan data.

Geomagic Control X makes it easy to get the inspection results you need from your 3D scanner, so more people in your organization can:

- Measure faster
- Measure more completely
- Measure more often
- Measure anywhere



**3D SCANNING AND INSPECTING PARTS WITH CONTROL X IS UP TO 7X FASTER THAN WITH A CMM**

# What's Next?

Learn more about Geomagic Control X

Our experts can help you find the right 3D scanner, connect you with a local partner, and answer questions.

[Get in Touch](#)