

# A NEW LENS ON REALITY:

3D LASER SCANNING  
FOR SURVEYORS



**KEYSTONE**  
PRECISION SOLUTIONS



# INTRODUCTION

Driven by demand for enhanced interactive and immersive experiences, virtual reality, Internet of Things (IoT), quantum computing, AI and smart cities, the global 3D laser scanning market is estimated to reach \$8 billion by 2025.

Scanning technology is transforming numerous industries already by providing detailed, accurate and rapid data collection capabilities, giving surveyors and other geospatial professionals the ability to handle complex projects that traditional methods cannot match.

With expanding applications in industries like construction, manufacturing, transportation infrastructure, automotive, healthcare, industrial, engineering and many more, scanning is a valuable tool for surveyors and others who utilize geospatial data at scale.

As the laser scanners and scanning total stations themselves become easier to use, with improved quality and more portability, the increased demand fuels opportunities and business goals. The evolution of computer hardware, CAD software and scanning field technology has resulted in increased integration of reality capture data (scanning data of point clouds and images) into BIM workflows, enhancing project productivity from conception to completion.

# WHAT'S THE VALUE OF REALITY CAPTURE DATA?

**\$8 BILLION USD**

**MARKET VALUE OF 3D LASER SCANNING MARKET WORLDWIDE**

A detailed 3D point cloud provides significant value across various industries by offering precise, comprehensive digital representations of the physical world.

**Benefits include:**

- Ability to take highly-accurate and detailed measurements for planning, design and analysis
- Reduces time-on-site by capturing detailed data quickly
- Easily shareable digital data to enhance stakeholder access and review, streamlining collaboration and decision-making
- High-fidelity data for a solid foundation for making informed decisions, minimizing errors and rework
- Creates an accurate record of existing conditions, invaluable for renovation, restoration and maintenance
- Reduces the need for people to physically access dangerous or hard-to-reach areas
- Ensures projects comply with local regulations with verifiable data



A close-up photograph of a 3D laser scanner's lens, showing a circular opening with a dark interior and a metallic frame. The scanner is white and the background is a blurred blue.

# RECENT ADVANCEMENTS AND SOLUTIONS

## SIMPLIFYING COMPLEXITY

Modern 3D laser scanners are designed with the user in mind, requiring minimal training. This accessibility allows surveyors to quickly adopt and seamlessly integrate scanning into their workflows, enhancing productivity and decision-making capabilities. The workflows themselves are also easier to follow, making it easier for anyone without a technical background to learn how to use a scanner.

## ENSURING DATA INTEGRITY

The latest scanning solutions offer advanced features like in-field registration and self-leveling, creating detailed point clouds on-site easily. This capability ensures that you can capture complete and accurate data the first time, reducing the need for return visits and mitigating the risk of costly errors. Self-leveling also saves time when scanning, and makes the instruments easier to use for inexperienced users as the scanners don't have to be placed precisely or leveled by hand.

## REDUCING DOWNTIME

Innovations in scanner maintenance, such as self-calibrating technologies, have minimized the need for frequent servicing. These advancements keep equipment operational and available, supporting continuous productivity. Instruments without self-calibration have to be serviced annually to ensure survey-grade accuracy is retained, leaving you without a scanner for weeks or months.

## SHARING DATA

Historically, laser scanning has been seen as a complex technology to adopt, with legacy systems reliant on cumbersome data sets, incompatible file types, complex software and no way to easily view advanced data; and without specialized software and experience, reality capture data has been difficult to scale. But new solutions have made it easier. Sharing point cloud data is possible now through cloud- and web-based platforms, giving access to anyone with an internet connection, democratizing the data, reducing friction between users, removing delays and making it easier for anyone to maximize the value of reality capture data.

# INCREASING ADOPTION ACROSS INDUSTRIES

# 47%

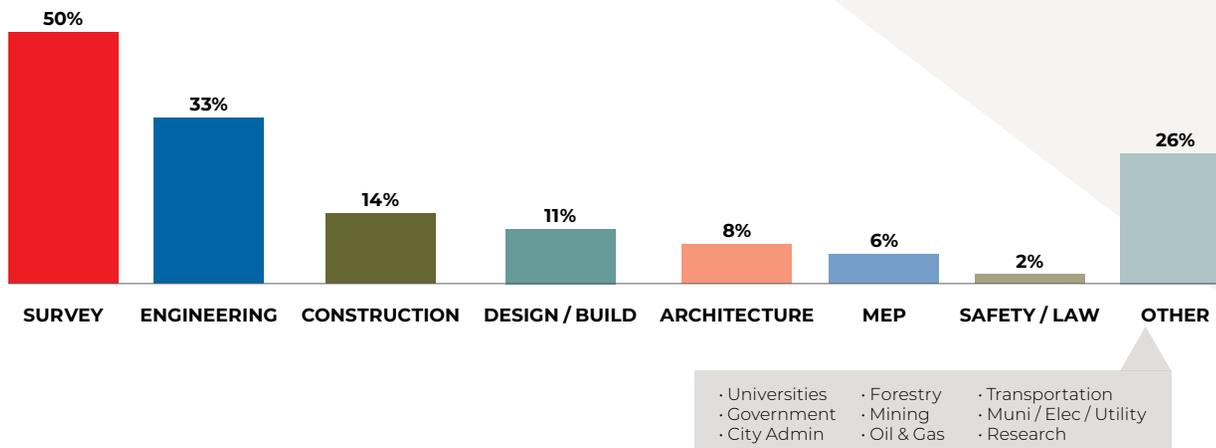
**OF SURVEYORS  
WORLDWIDE ARE USING  
3D LASERS SCANNING\***

\*SOURCE: TRIMBLE MARKET RESEARCH 2024

## PRECISION AND EFFICIENCY

Of the types of surveying, 3D laser scanning is the only type that has steadily increased in the last three years, from 37% to 47%, according to a 2024 Trimble industry survey. And it has remained the toptype of surveying that

companies want to invest in, from 25% in 2020 to 39% in 2023. Companies across industries are using scanners for projects either for a standalone scan, or as a part of a larger workflow.



## TOP SCANNING USES

- Enhance traditional survey methods
- Land topography and structures
- Roadway design, construction and repair
- Bridge design, construction and repair
- Water and sewer facilities and lines
- Parking lot build and repair; pavement grading
- Site planning and fitting of components (involving constant re-scanning)
- Building construction, design, remodeling and maintenance
- Piping, HVAC and electrical design
- Internal and external building mapping
- Structural integrity and fit for insurance
- Heritage architecture preservation, reconstruction and documentation
- Manufacturing and fabrication to measure precise dimensions, angles and curves
- Real-time development and adjustments
- Sculptures and artwork
- Forensics uses like car accident and crime scene capture
- Archeological records, like recording dinosaur footprints
- Hollywood movie sets for set design and continuity checks

# HOW SURVEYORS ARE USING LASER SCANNING BY APPLICATION



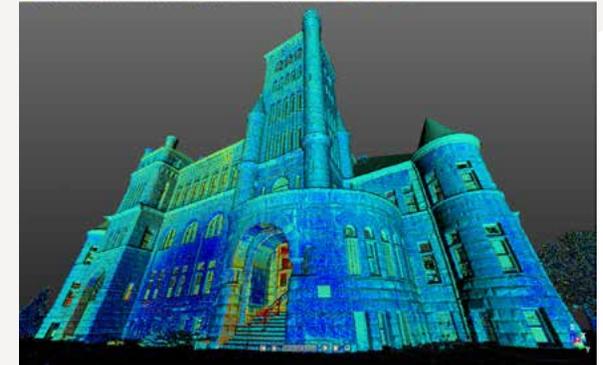
## TOPOGRAPHIC SURVEYS

Topographic surveys provide comprehensive and critical information for design and mapping projects, where every detail matters. Unlike conventional methods, a scanner or scanning total station offers a way to quickly and reliably capture every detail of a job site, even the ones you didn't know you needed. Point clouds provide rich, contextual data to easily define topography, dimensions and features such as hydrants, curbs, manholes and more that can be visualized and shared with stakeholders with or without a technical understanding.



## BUILDING INFORMATION MODELING (BIM)

In retrofit construction projects, existing structures rarely have accurate plans, if any plans exist at all. Laser scanners offer fast and reliable means of capturing every critical aspect of the building to aid engineers in designing new systems, supports and more. For new build projects, getting the real world to match the digital rendering is a daunting task, but with detailed point clouds supporting the process, users can capture precise measurements onsite to create or update accurate digital representations of construction as it progresses.



## HISTORICAL PRESERVATION

Preserving the world's landmarks and sites of cultural significance is critical to maintaining our history and sense of community. Laser scanning captures accurate, dense 3D datasets that ensure every intricate detail of the world's structures is recorded and digitized for future generations to experience. Point clouds are used to help restore damaged landmarks as well, including the recent reconstruction of the Notre-Dame de Paris cathedral following significant fire damage in 2019. Thanks to accurate scan data, reconstruction of the cathedral is an exact recreation of its former structure, down to every last detail.



## CIVIL ENGINEERING

In civil construction projects, comparing the real world to the engineering design is pivotal to validate the quality of work over time and drive payment approvals. Where traditional methods require the laborious collection of vast singlepoint observations to generate comparison surfaces, scanners capture millions of points per second, helping to generate dense and reliable digital terrain models (DTMs) in minutes.



## VOLUME CALCULATIONS

In many industries, the accounting is driven by volume calculations detailing the quantities of various materials. In quarrying, mining, earthwork, infrastructure and others, payment is driven by the amount of material moved over time. Getting these volumes is critical, and conventional methods often only provide rough estimates that can be unsafe and slow to capture. With a dense point cloud, volume can be easily and accurately captured without users needing to set foot on the stockpile itself. This dataset can be compared to future scans to compare change-over-time data and track progress throughout the life of the resource.



## URBAN PLANNING AND DEVELOPMENT

Scanning helps support the urban planning processes with detailed 3D models and orthophotos of urban landscapes, including buildings, roads and vegetation, ensuring that urban spaces are planned and managed with the community and the environment in mind.



## FORENSICS AND ACCIDENT RECONSTRUCTION

When an accident or a crime happens, first responders need to act fast and capture critical details before the scene is altered. With so little time to capture myriad details, scanning is the reliable option. Offering an easy way to safely and rapidly capture detailed recreations, laser scanners empower reliable forensic analysis and detailed reconstruction that can be trusted to withstand trial and intuitively convey the circumstances involved in any case.



## **INDUSTRIAL AND MECHANICAL**

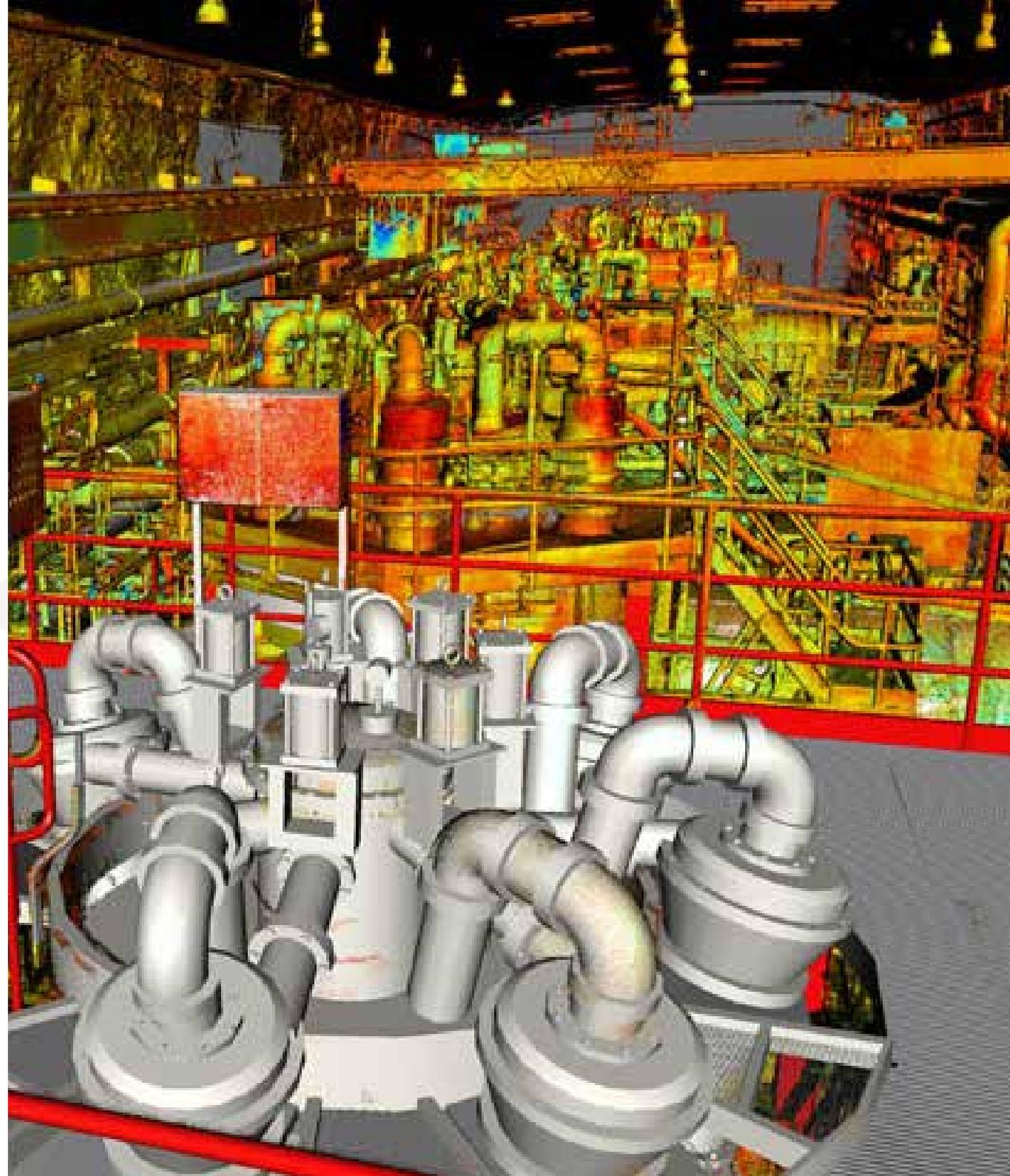
In extremely dangerous environments, scanning facilitates the design, inspection and maintenance of industrial plants, machinery and infrastructure by providing detailed 3D models and measurements. Fabricators can work in the relative safety of a controlled shop, with the confidence that pieces will fit together seamlessly the first time.

## **ENVIRONMENTAL STUDIES**

Just as scanning protects the built environment, it can help protect the natural environment. Scanning assists in environmental monitoring and research by capturing detailed 3D models and DTMs of landscapes, vegetation and erosion for analysis and modeling.

## **INSURANCE AND RISK ASSESSMENT**

Following natural disasters or accidents, scanning can document property and infrastructure for insurance purposes, risk assessment and damage analysis, providing orthophotos, detailed assessment reports, damage analysis documentation and 2D CAD drawings to regulators and assessors.





## CASE STUDY

# SURVEYING

**Challenge:** Surveyor Willis Long faced increasing competition and the need to deliver more precise data while reducing costs for his company, Layton Surveys. Traditional surveying methods were time-consuming and less accurate, which limited the ability to win new jobs and meet client expectations.

**Solution and results:** By adopting scanning technology, Long significantly enhanced data capture capabilities, providing high-resolution and accurate measurements quickly. This not only improved project efficiency, but also cut operational costs. The advanced technology enabled Layton Surveys to offer superior services, leading to increased client satisfaction and the ability to secure more projects. The transition to scanning proved to be a game-changer, positioning them as a leader in the competitive market.



**Four SX10 scanning total stations paired with the X9 were indeed able to capture the entire city block! The updated version of Trimble Perspective stitches the X9 scans together amazingly even in suspect conditions. Between the SX10 data and the X9 data we ended the day with just shy of 200 scans!**

**For reference, I did this same survey almost 12 years ago, with a rag tape and a 2 man robot team and it took me about 3 months to get the same amount of data that I did with 5 teams in one day.**

Land surveyor and CEO Willis Long,  
Layton Surveys in Salt Lake City, Utah, USA



## CASE STUDY

# CONSTRUCTION

**Challenge:** BIM GIS CONCEPT SRL in Romania, led by surveyor Cristian Gheorghe, faced the need to collect extensive and precise data efficiently for large-scale projects involving multiple teams. Traditional surveying methods were time-consuming and prone to human error, making it difficult to achieve the required level of detail and collaboration necessary for modern BIM projects.

**Solution and results:** By integrating 3D laser scanning, BIM GIS CONCEPT SRL revolutionized its surveying processes. The technology enabled the collection of vast amounts of data in a significantly shorter timeframe with unmatched precision, reducing human error to nearly zero. This advancement facilitated better collaboration among architects, engineers and clients, enhancing project visualization and execution. A notable project involved scanning an 1800s house on the verge of collapse to assist in its reconstruction. The detailed point cloud data provided to architects ensured the historical accuracy of the rebuild.

“

**The data visualization (be it a point-cloud or as-built model based on 3D laser scan) is better than ever before. It's easy to work with! Just push and play! There are less mistakes; human error is reduced to almost zero! I for a fact, don't see a future in the construction industry without laser scanning.**

”

Geodetic engineer Cristian Gheorghe,  
HIM GIS Concept SRL in Bucharest, Romania





## CASE STUDY

# MARINE

**Challenge:** The marine industry faces significant challenges in accurately measuring and documenting the complex geometries of ship hulls and other marine structures. Traditional methods were labor-intensive, time-consuming, and often resulted in incomplete or inaccurate data, which could affect maintenance and retrofitting projects.

### **Solution and results:**

By adopting scanning technology, Danie Roelvert and his company, PinPoint 3D, achieved unprecedented precision and efficiency in capturing detailed measurements of marine structures. The technology enabled seamless data collection and visualization of intricate geometries, facilitating more accurate maintenance, retrofitting and construction processes. This innovation led to significant time and cost savings while improving the overall quality and safety of marine projects.



**Laser scanning is the perfect and only answer to this problem. Ships are in port for a limited time so you need to work efficiently and ensure you collect everything because you don't have another opportunity to rescan once the ship sets sail. The speed, versatility and data density of laser scanning enables you to quickly set up in cramped spaces and capture the fine, detailed elements of entire engine or pump rooms in a few hours. With that virtual environment, designers can place pipes exactly where they need and ensure they'll tie together.**



Engineering surveyor and owner Danie Roelvert, PinPoint 3D Pty Ltd in Pretoria, South Africa

## CASE STUDY

# TRANSPORTATION INFRASTRUCTURE

**Challenge:** Aiming to stay at the forefront of technological development in surveying and mapping, Swedish engineering and consulting company AFRY always seeks innovative methods to improve accuracy, efficiency, and safety in their projects.

**Solution and results:** Leveraging its advanced capabilities, the team tested a scanner in various scenarios, including high-altitude scans at road intersections and difficult-to-access industrial buildings. It proved to be a valuable complement to their existing total station equipment, enhancing their ability to perform georeferenced scans and speeding up the data capture process. This innovative approach allowed AFRY to demonstrate improved methodologies, such as using the scanner upside down for traffic safety projects on the E4 highway.

“

**At intersections and junctions where it can be difficult to capture everything, you can hoist it very high and scan in that way.**

**We often work on the premise that we don't know everything we need to measure when we're out. We make sure to scan every time we set up somewhere. That means you capture a lot of data.**

”

Surveyor and section manager for surveying and mapping, Lennart Gimring, AFRY in Stockholm, Sweden



# THE FUTURE OF SURVEYING WITH 3D LASER SCANNING

The integration of scanning into surveying practices is revolutionizing the field. Surveyors equipped with this technology can expect to see significant benefits, including:

## ENHANCED PRECISION AND EFFICIENCY

User-friendly instruments enable rapid data collection and faster processing speeds up project timelines.

## IMPROVED DATA QUALITY

High-resolution scans provide detailed insights for analysis and planning to answer the future questions you don't know you have yet.

## INCREASED VERSATILITY

The ability to handle diverse surveying tasks with a single tool streamlines operations, enhancing or replacing traditional methods in a variety of industries.



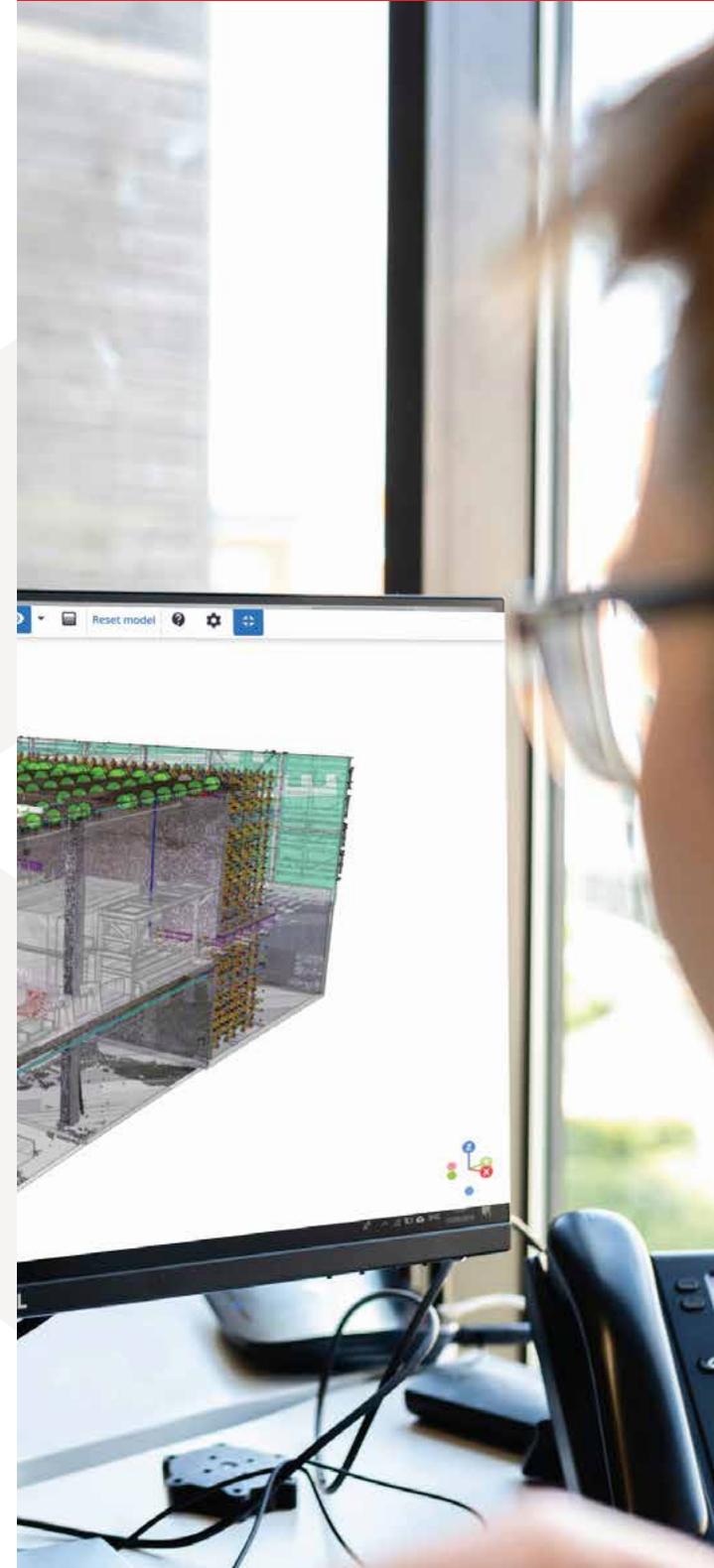
# UNLOCK THE POWER OF SCANNING WITH CLOUDBASED COLLABORATION

Sharing massive point cloud datasets has long been a challenge for surveyors. These data files are often too large to share easily, and accessing them requires powerful, specialized software and high-end hardware like gaming laptops. This makes collaboration with clients, stakeholders and project partners difficult, leading to delays and inefficiencies.

Cloud-based solutions now offer an alternative. By moving point cloud and image data to the cloud, surveyors can eliminate the need for heavy-duty equipment and complex software. With just an internet

connection, anyone on a desktop, tablet or even a smartphone can view, interact with and analyze scanning data.

This streamlined accessibility allows surveyors to offer a more fluid, user-friendly experience to clients, enhancing communication and enabling faster project turnarounds. The ability to easily share deliverables and insights gives surveyors a distinct edge, positioning them as partners who provide exceptional service, helping build long-term business relationships.





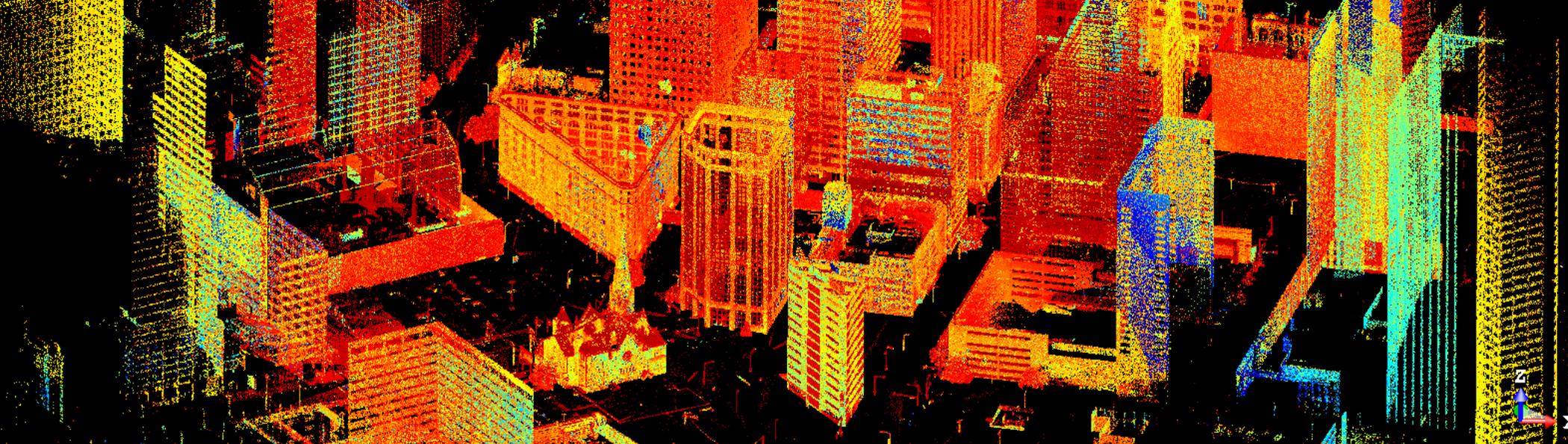
## FAQs

### WHAT ARE THE DIFFERENCES BETWEEN SHORT-RANGE AND LONG-RANGE SCANNERS?

Short-range scanners are designed for capturing detailed measurements over shorter distances, typically within a few meters, and are ideal for applications like indoor mapping and industrial inspections. Long-range laser scanners, on the other hand, can capture data over several hundred meters and are used for large-scale outdoor surveys, such as topographic mapping and infrastructure projects.

### WHICH PERFORMANCE SPECIFICATIONS AND FEATURES MAKE SCANNERS UNIQUE?

Laser scanners are unique due to their high accuracy, precision and the ability to capture millions of data points in only minutes. Key performance specifications include range, point density, scan speed, field of view and accuracy. Advanced features often include automatic scan registration, real-time data processing and integration with other surveying instruments and software.



## HOW CAN I SAVE TIME WITH A SCANNER IN THE FIELD?

Scanners with auto-calibration and self-leveling features save significant time by automating the initial setup and ensuring optimal accuracy without manual intervention. Auto-calibration reduces the need for frequent manual adjustments and ensures the scanner is always operating at peak performance. Self-leveling ensures that the scanner is properly aligned before each scan, reducing setup time and minimizing errors. These features allow surveyors to focus on data collection and analysis, streamlining the overall workflow and enhancing productivity.

## HOW CAN I SAVE TIME IN POST-PROCESSING BACK IN THE OFFICE?

Automatic scan registration in the field allows surveyors to align and merge multiple scans in real-time, reducing the need for extensive post-processing in the office. This feature ensures that data is correctly aligned on-site, saving significant time and effort in the office for data cleaning, alignment and processing.

## HOW CAN I MANAGE THE LARGE QUANTITY OF DATA PRODUCED BY A SCANNER?

Managing the large quantities of data produced by a scanner can be effectively handled through several strategies. Utilizing data compression and efficient storage solutions, such as high-capacity SSDs, can help manage the volume. Additionally, employing specialized software allows for the segmentation and filtering of point clouds, focusing on relevant data while discarding unnecessary information. Cloud storage and processing services can also be leveraged to store and manage data remotely, enabling easy access and collaboration without overloading local resources.

## WHAT CAN YOU ACTUALLY DO WITH A POINT CLOUD?

A point cloud is used to create detailed 3D models and digital representations of the surveyed area. It can be processed and analyzed for various applications, including creating BIM models, conducting structural analysis, volume calculations, and generating accurate topographic maps.

## HOW DOES SCANNING COMPARE TO CONVENTIONAL DATA CAPTURE?

Scanning data provides higher accuracy, speed and detail compared to conventional data capture methods. It captures comprehensive and dense datasets in a fraction of the time, with minimal human error, and can be used in environments where traditional methods may be challenging or unsafe.

## WHAT IS THE COMPLETE WORKFLOW WHEN USING A LASER SCANNER?

The complete scanning workflow involves planning the survey, setting up the 3D laser scanning system, capturing the data, then processing the data. With field software, you can capture and perform initial processing of the scans in the field. The data is then transferred to office software for detailed processing, analysis and creation of deliverables such as 3D models, point clouds and topographic maps. Cloud storage can be used to both store and share the massive datasets created by scanning systems.

## HOW LONG DOES IT TAKE TO LEARN HOW TO SCAN? WHAT IS THE SET-UP PROCESS?

Learning to operate a scanner can take a few hours to a couple of days, depending on the complexity of the equipment and the user's familiarity with surveying technology. The set-up process is very simple as compared to older equipment, and involves positioning the scanner, calibrating it (or waiting for self-calibration), selecting the appropriate settings for the survey, and performing a test scan to ensure accuracy before capturing the full dataset.





# RESOURCES AND MORE INFORMATION



[Scanning 101  
How to get started](#)



[Scanning 101  
Understanding the  
display settings](#)



[Explore terrestrial  
3D laser scanning  
and imaging systems](#)



[LinkedIn: Top people  
in the 3D industry  
you should follow](#)